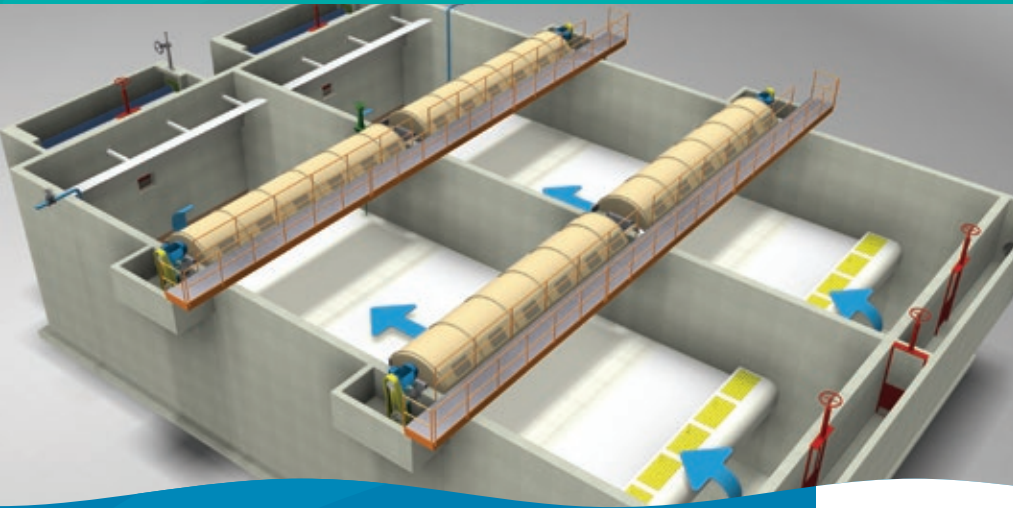




# CLR Process

Vertical Loop Configuration



Cleaner Water for a Brighter Future®



# Vertical Configuration System Flexibility

## Parallel Operation

Raw wastewater and return activated sludge are introduced at a single point in each standard CLR basin. Dissolved oxygen content in the mixed liquor in each basin is maintained at the same level. Only DO control is needed. Oxygen input is controlled automatically by adjusting rotor speed to match the DO requirement in the influent. Immersion level is usually kept constant. The rotational speed of the rotor is varied to adjust the oxygen input to maintain a constant DO level. Each CLR tank is provided with its own adjustable weir for coarse DO adjustment. This simple operation can provide high levels of BOD5 and TSS removal while meeting effluent  $\text{NH}_3\text{-N}$  levels of 1 mg/l or less.

## Series Operation

In series operation, raw wastewater and return activated sludge enter CLR Reactor No. 1 and then flows on to Reactor No. 2, then 3 and so forth until entering the last CLR in the series and out of the system over the effluent weir of the final CLR tank. Anoxic conditions are maintained in CLR No. 1 because the  $\text{O}_2$  demand is much higher than the DO provided. Each additional CLR in the series is designed to meet additional  $\text{O}_2$  demand, varying the environmental conditions provided over a range differing from very anoxic to aerobic. This allows these zones to be used for nutrient removal. Again, rotor immersion is usually fixed. Rotor speed and recycle flows are controlled to match the oxygen demand required for the appropriate condition. Oxygen levels in the last CLR reactor are maintained aerobically to assure  $\text{NH}_3$  reduction and BOD oxidation prior to discharge.

*Spiraflo Clarifiers*



## Peak Flow Hydraulic Capacity

During peak flow conditions, solids from the system are forced to travel rapidly to the final clarifiers. If this rate exceeds the returned solids rate, clarifier solids build and washout will occur. To prevent solids washout, Lakeside's peak flow operation introduces influent wastewater into the 2nd or 3rd CLR reactor downstream while returning RAS to the first CLR reactor. This converts the operation from its normal series mode for BNR to a contact/stabilization process during the time the peak flow is occurring. The RAS then flows through the first CLR and meets the influent in No. 2 or No. 3 CLR at the same rate that it is pumped from the clarifier. This operation sends less sludge to the clarifiers during peak flow conditions,

reducing clarifier washout. The RAS is stored in the stabilization stages. This maintains sludge inventory in the system, keeping it ready to return to series BNR operation when the peak flow condition subsides.

**The CLR Process – Vertical Loop Configuration offers a very cost-effective solution for applications that need to fit biological nutrient removal capability into a small footprint. Whether it's a greenfield approach or an existing facility upgrade, Lakeside's CLR Process – Vertical Loop Configuration provides the answer. Let our experienced engineering staff show how this process can be designed into your facility.**



# The Vertically Configured CLR Process

Lakeside Equipment Corporation's vertical loop configuration version of our Closed Loop Reactor (CLR) Process offers all the treatment capability and operational flexibility of the conventional CLR process in a small footprint. This product is ideal for new treatment facilities or existing system expansions where space is a premium.

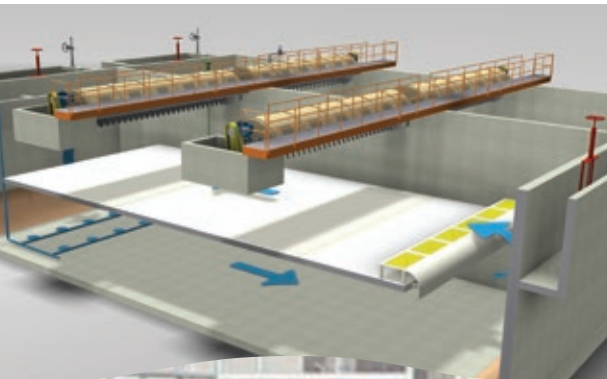
## Features and Benefits

- Vertical rotation of the mixed liquor suspended solids (MLSS) within segregated environmental zones of equal volume, allowing maximum control of biological nutrient removal processes
- Side water depths of up to 22 ft. are possible
- Common wall construction of side by side tanks
- Increased depth and common wall construction creates a cost-effective treatment system design within a small footprint
- Efficient addition of air below the baffle allows the design to handle higher organic loading rates than other oxidation ditch designs while saving energy

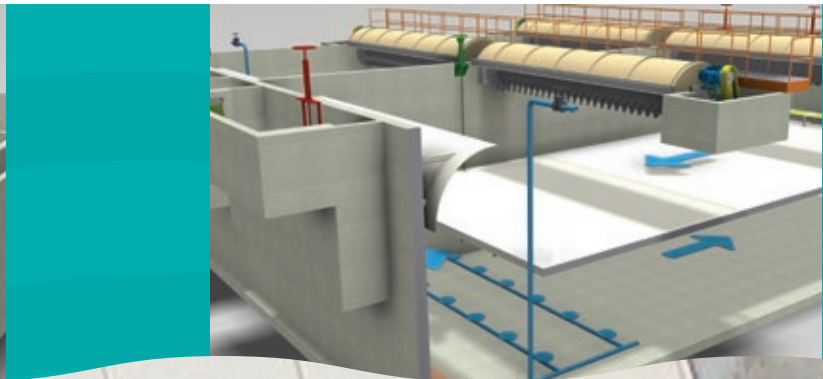
## Vertical Rotation Application

Vertical rotation of the MLSS is possible because structurally sound turning vanes force the forward energy generated by Magna Rotors on the tank surface downward around a concrete baffle situated in the center of the tank. The baffle wall separates the upper velocity generating zone from the lower oxygen transfer zone. Concrete fillers are used in the bottom corners of the vertically orientated tanks to provide additional enhancement of the vertical MLSS rotation.

*Flow Path*



*Turning Vane*



# Power and Efficiency

## Energy to Velocity

Velocity is generated in the upper level of the vertically oriented CLR tank by the Magna Rotors. These rotors are highly efficient energy transfer devices that also add a known amount of oxygen to the system. Their energy and  $O_2$  input is dependent on the depth of immersion and speed of operation selected. Since the main purpose of the Magna Rotors in the CLR design is to provide energy for mixing and rotation, the immersion is commonly fixed. Speed variation can be used to change the  $O_2$  input to match the demand, as indicated by the associated ORP or DO probes used for control of each zone.

## Maximum Oxygen Transfer Flexibility

The lower level of the vertically oriented tank is commonly designed for final adjustments of  $O_2$  input required to

attain the environmental conditions needed to complete the treatment process. To maximize this efficiency, a coarse bubble diffusion grid is located directly under the baffle at the upstream end of the lower level. A low horsepower, positive displacement blower is used to feed air into the MLSS through this diffusion grid. Bubbles then rise to the bottom of the baffle, transferring oxygen into the MLSS. The baffle intercepts the bubbles. The baffle is designed with a slight slope to carry the coalesced air toward the downstream end. Sheets of coalesced air are kept separate by strategically embedded air distribution baffles placed along the entire length of the concrete baffle. Contact between the air and the MLSS is maintained as the air moves along the concrete baffle towards its downstream edge.

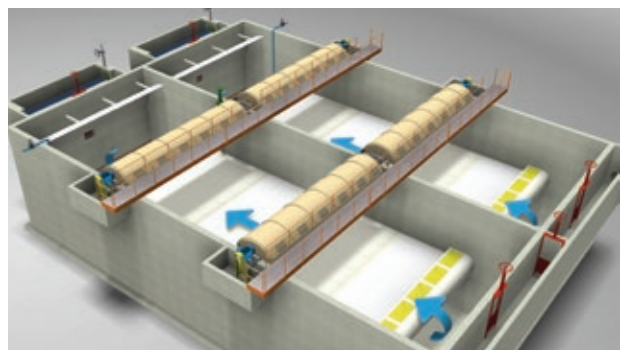
*Air Release*



*Magna Rotors*

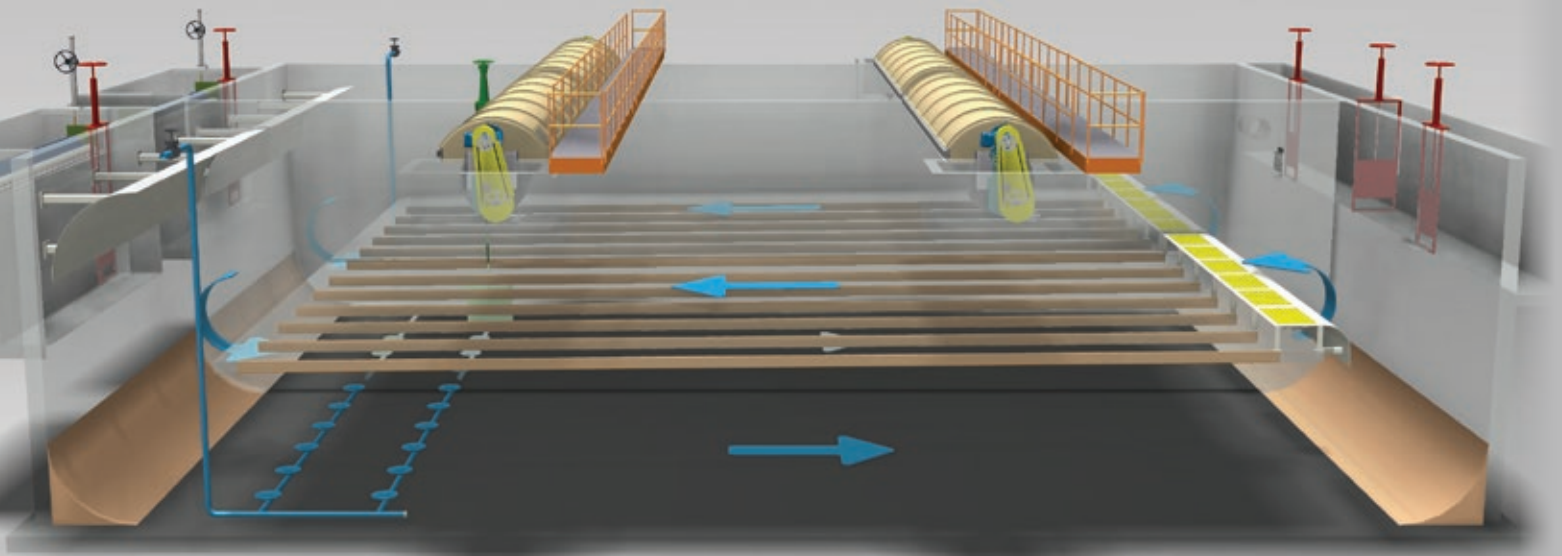


At the downstream edge of the baffle, an air-flow turning vane catches the air as it emerges from the bottom of the baffle and then distributes it through a grid of perforated plates. The perforations in these plates re-distributes the coalesced air into coarse bubbles which then rise to the surface. Maximum oxygen transfer from this air is obtained because the length of time the bubbles are kept in contact with the MLSS is significantly increased. Whereas air released at the bottom of a tank would rise directly to the surface, in the vertically oriented tank, it is intercepted by the baffle and caused to flow along the baffle's entire length, then re-released to the surface. This dramatically increases the amount of time a quantity of air is maintained in contact with MLSS and increases the amount of oxygen transferred from that quantity of air proportionately.





## Smaller Footprint, Bigger Savings



*Fiberglass Covers*



*DO/ORP Control*

### **The CLR Process – ON ITS SIDE**

The vertically configured CLR process can support either parallel mode or series mode of operation. For biological nutrient removal (BNR), it is much more beneficial to operate the system in a series mode. In this manner, the CLR tanks can be distributed as separate environmental zones. Anoxic environments are useful for phosphorus and nitrogen removal. The condition of anoxic zones can be monitored by ORP Probes. Lakeside's Sharp-BNR control system will monitor these conditions and send signals to VFD's or PD blowers to start / stop or speed up / slow down these aeration devices to maintain the environment at the set-point selected by the operator, providing precise control of the environment. It has been shown that controlling the environmental conditions within BNR processes increases the efficiency of nutrient removal.

### **Cost-Effective Solution**

Unlike the multiple loop reactors which have a larger outer channel volume flowing inward into smaller interior volumes, the vertically configured zone volumes are identical. Therefore, an equal amount of detention time exists in anoxic zones and in aerobic zones. Equal distribution of the detention time in each zone allows for increased nutrient removal reliability. This is especially important in nitrification processes, where maintaining effluent ammonia levels at low discharge levels are critically important. The vertically configured CLR process has the benefit of equal volumes for each zone, and because of its increased depth and oxygen transfer capability, it also has a much smaller footprint. It is truly a cost-effective solution for both industrial and municipal applications.

# Treatment equipment and process solutions from Lakeside Equipment Corporation

Lakeside offers a wide range of equipment and systems for virtually all stages of wastewater treatment from influent through final discharge. Each process and equipment item that we supply is manufactured with one goal: to reliably improve the quality of our water resources in the most cost-effective way. We have been doing just that since 1928.

## **Screw Pumps**

- Open Screw Pumps
- Enclosed Screw Pumps

## **Raptor® Screening**

- Fine Screen
- Micro Strainer
- Rotating Drum Screen
- Septage Acceptance Plant
- Septage Complete Plant
- Complete Plant
- Multi-Rake Bar Screen
- Wash Press

## **Screen and Trash Rakes**

- Hydronic T Series
- Hydronic K Series
- Hydronic Multifunctional Series
- Hydronic H Series
- Catronic Series
- Monorail Series
- HY-TEC Screen
- CO-TEC Screen
- RO-TEC Screen

## **Grit Collection**

- SpiraGrit
- Aeroductor
- In-Line Grit Collector
- Raptor® Grit Washer
- Grit Classifier
- H-PAC®

## **Clarification and Filtration**

- Spiraflo Clarifier
- Spiravac Clarifier
- Full Surface Skimming
- MicroStar® Filter

## **Biological Treatment**

- CLR Process
- Magna Rotor Aerators & Accessories
- Sequencing Batch Reactors
- Package Treatment Plants
- Submersible Mixers & Recirculation Pumps

## **Hauled Waste Receiving Systems**

- Raptor® Septage Acceptance Plant
- Raptor® Septage Complete Plant

## **Package Headworks Systems**

- Raptor® Complete Plant
- H-PAC®

## **Biological Treatment Systems**

- CLR Process
- Package Treatment Plants
- Sequencing Batch Reactors



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