

EWT™ Carrousel® Systems

UNR™ Series

Key features & benefits

- Aeration rate of 3.65 lb O₂ / motor HP - hr with alpha values ≥0.9
- Total Nitrogen and Total Phosphorus Removal-biologically
- Free IR (Internal Recycle)
- Excell® Aerator power turndown of up to 90%
- Reduced power consumption of up to 80% with LM™ Mixer

How we create value

- Cutting maintenance and operational requirements
- Reducing plant energy costs
- Providing industry-leading process support
- Meeting the most stringent U.S. nutrient permit limits – easily



EWT™ Carrousel® Systems

With over 700 US installations, Ovivo's EWT™ Carrousel® System is universally praised for its durability, operational simplicity, low operating and maintenance costs and consistently high effluent quality. Original partners DHV B.V. of the Netherlands first developed the Carrousel technology in the 1970s. To this day they continue to work in partnership with Ovivo to improve and perfect the Carrousel system, which is now one of the most widely accepted processes available for biological wastewater treatment.

System Overview

The Excell® Aerator is installed at one or more of the channel turns and provides all aeration and mixing requirements for nitrification and BOD (Biochemical Oxygen Demand) removal. The Excell Aerator propels aerated mixed liquor from zones of intense aeration towards quieter downstream

channels, where it recirculates at an average of 100 times the influent flow rate. This provides protection against shock loading and eliminates short-circuiting.

Dedicated anoxic and anaerobic basins are easily added for Total Nitrogen and Total Phosphorus Removal. LM™ Mixers or EWT™ Submersible Mixers are installed in these unaerated zones.

Using a Modified Lutzack-Ettinger (MLE) configuration called the denit/R® system, Internal Recycle (IR) between the aerobic and anoxic zone occurs via the IR channel without the use of pumps or supplemental carbon. Using propulsion generated by the Excell Aerator, IR requires no additional power. IR flow is varied by the Eliminat/R™ Gate. The Oculus™ Control System automatically controls aeration rate and IR flow.

Activated sludge
treatment and Biological
nutrient removal



EWT CARROUSEL® SYSTEMS
1979 - 2009

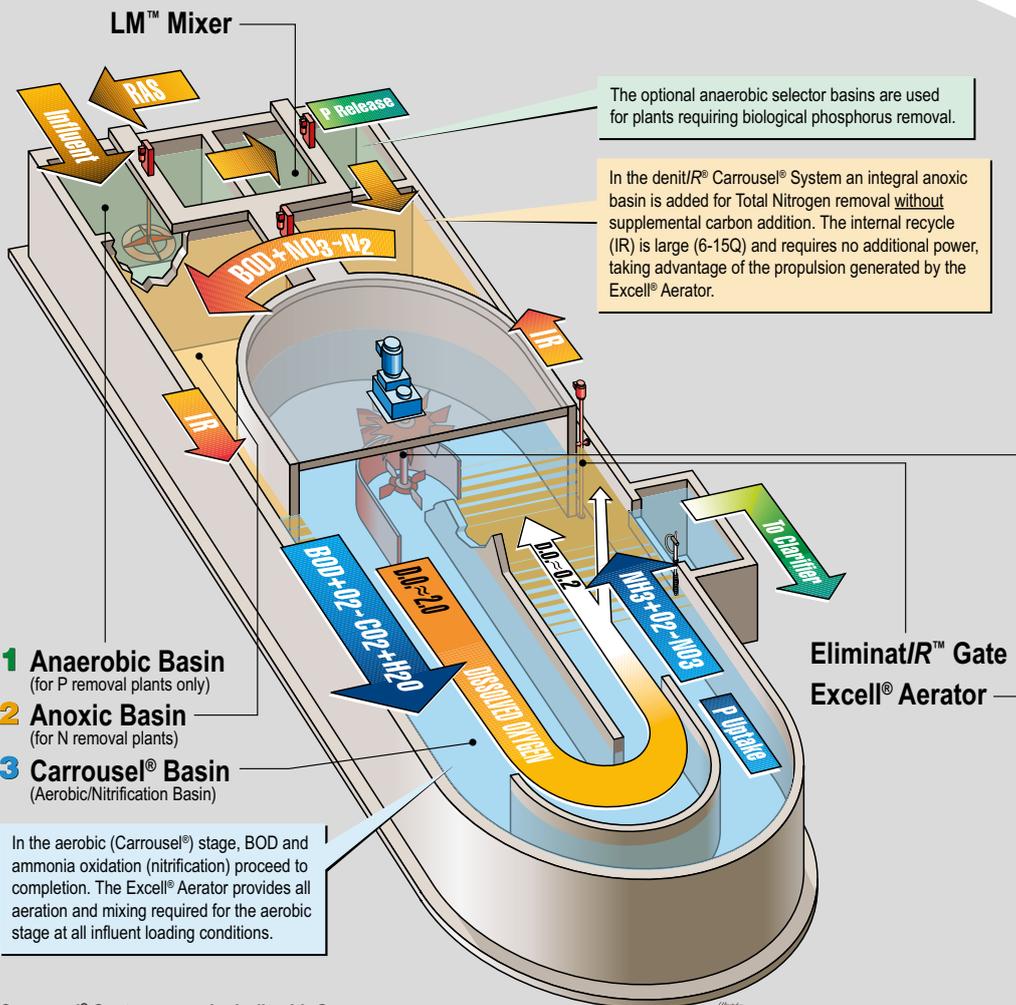
Total Phosphorus ≤ 0.3 mg/L
Total Nitrogen ≤ 3 mg/L

- Virtually eliminates $\text{NO}_3\text{-N}$
- Dedicated environments maximize N and P removal
- Optimization eliminates or greatly reduces metal salt addition
- No IR pumps required
- No supplemental carbon required
- Full nitrification to $\text{NH}_3\text{-N} < 0.5$ mg/L in all U.S. climates

Top: The Excell® Aerator is installed at one or more of the channel turns and provides all aeration and mixing required for full nitrification and BOD removal

Bottom: Anoxic and anaerobic basins are easily added for Total Nitrogen and Total Phosphorus removal in Ovivo's denit/R® configuration





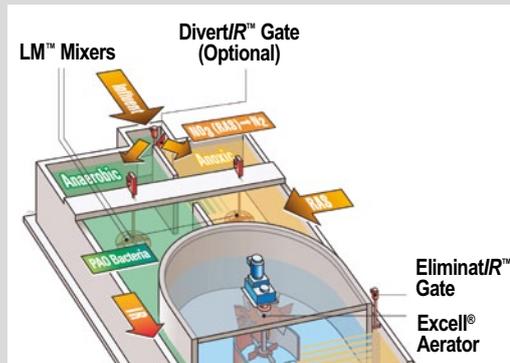
Carrousel® Systems may be built with One, Two, Three, Four or Five Stages.

(The Three Stage System is shown.)

	One Stage Carrousel® System	Two Stage denit/R® Carrousel® System	Three Stage A/C™ Carrousel® System	Four Stage Bardenpho® System	Five Stage Bardenpho® System
1 Anaerobic			●		
2 1st Anoxic		●	●	●	●
3 Carrousel	●	●	●	●	●
4* 2nd Anoxic				●	●
5* Re-Aeration				●	●
Effluent (mg/l)	BOD<5 NH ₃ -N≤0.5	BOD<5 NH ₃ -N≤0.5 TN<5-8	BOD<5 NH ₃ -N≤0.5 TN<5-8 TP,0.3**	BOD<5 NH ₃ -N≤0.5 TN<3	BOD<5 NH ₃ -N≤0.5 TN<3 TP<0.3**

* Not Shown in graphic above.

** Metal salt addition sometimes required to supplement bio-removal for lower total phosphorus effluent requirements. Carrousel® is a registered trademark of DHV B.V.



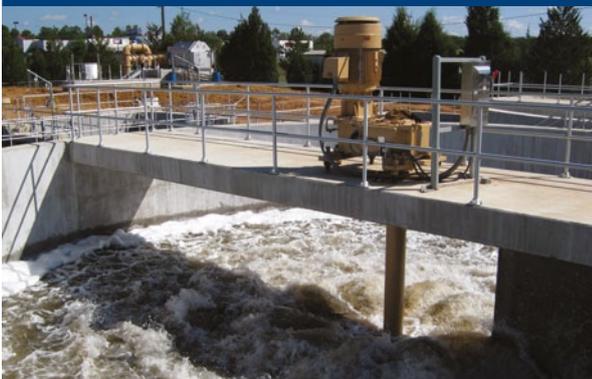
Alternat IR™ Modification

EWT™ Carrousel® Systems

EWT™ Excell® Aerator

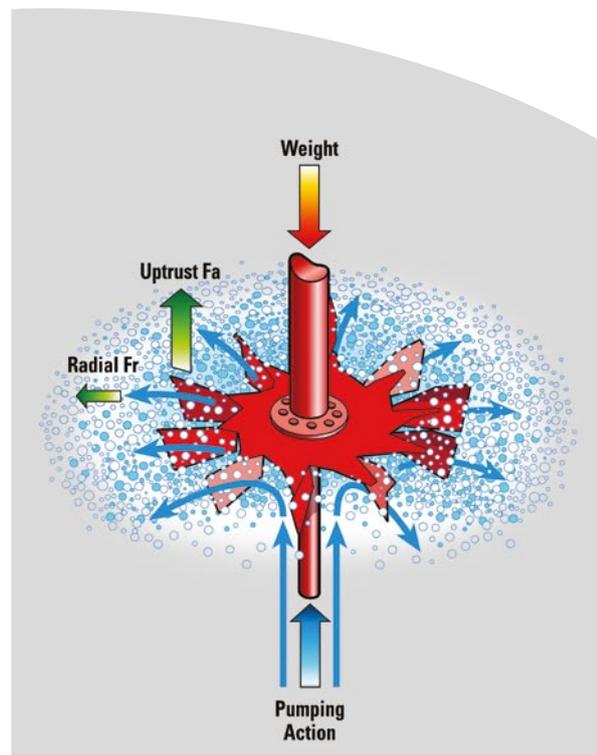
The EWT Excell Aerator consists of an efficient 10-bladed surface impeller, driven by a variable frequency drive, a premium efficiency motor and a highly efficient gear reducer. Rotating at between 15 and 50 rpm, the surface impeller acts as a pump, aerating and propelling mixed liquor into the basin channels.

- 3.65 lb O₂/motor HP-hr (3.85 lb O₂/shaft HP-hr)
- Power turndown up to 90%
- Just one man day maintenance each year



EWT™ Excell® Aerator at 30 Hz
(20% power, 80% turndown)

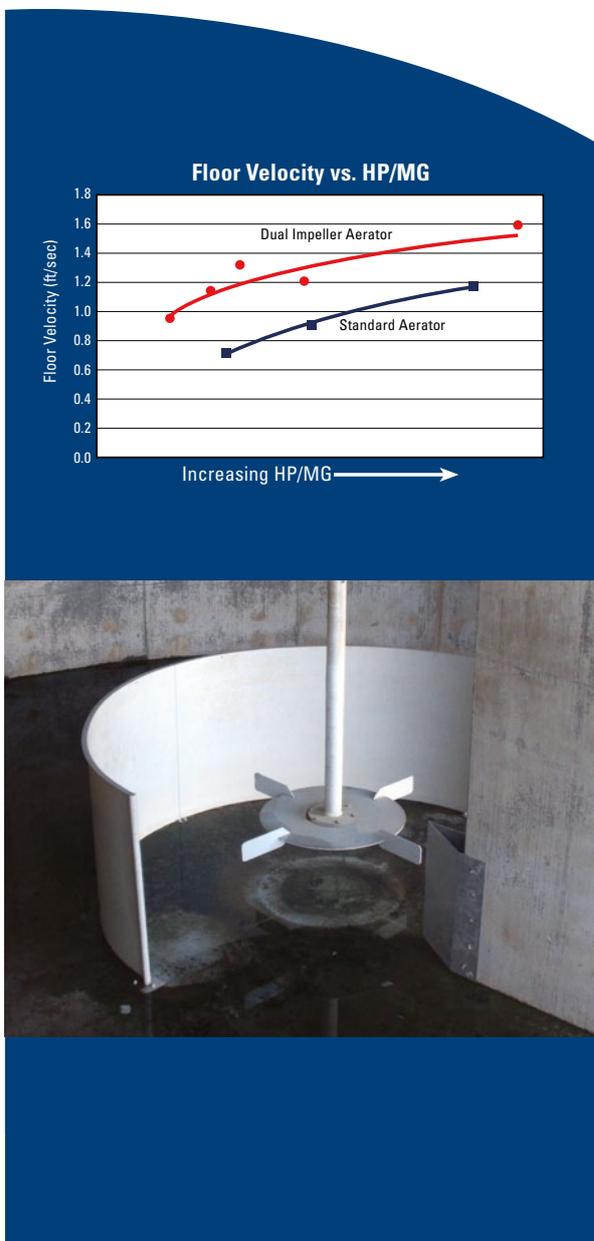
The surface impeller's star plate design results in low radial forces, ensuring long equipment lifespan. Maintenance is limited to regular greasing and oil changes, all performed from a clean concrete platform. No maintenance is required below the concrete deck. The Excell® Aerator is also available for complete-mix tank applications.



EWT™ Excell® Aerator at 60 Hz
(100% power, 0% turndown)

The clean water oxygen transfer efficiency of the Excell Aerator is a minimum of 3.65 lb O₂ / motor HP-hr (3.85 lb O₂ / shaft HP-hr). Operating with alpha values of 0.9 or higher, and with a high degree of denitrification, the actual wastewater oxygen transfer efficiency is equivalent to that of diffused air systems of similar depth. The 10-bladed surface aerating impeller has been approved by DHV, the sole authority for testing and certifying Carrousel System aerators.

The optional lower turbine provides extra floor scouring velocity in deeper basins and requires no additional equipment or bearings. Sidewater depths up to 25 feet are possible in Carrousel Systems. The lower turbine with velocity enhancement baffle is an ideal solution for plants which experience periods of very low influent flows (e.g., at night, or during the first few years of operation). Even at power turndown of between 80 and 90%, thorough mixing is still possible. Adequate power turndown is critical for biological nutrient removal facilities. The lower turbine may be removed with just six bolts at any time.



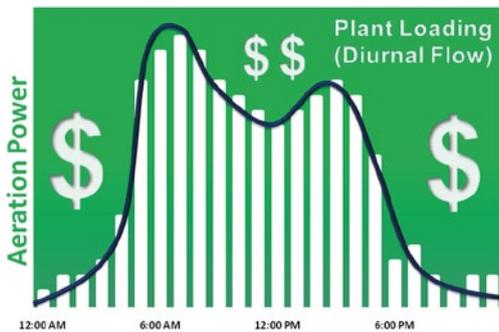
EWT™ Carrousel® Systems

EWT™ Oculus™ System

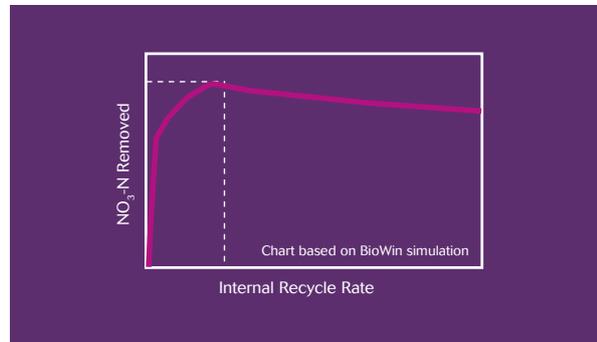
The EWT™ Oculus™ System analyzes and reports upon signals from a range of probes monitoring dissolved oxygen (DO), oxidation reduction potential (ORP), ammonia (NH₄-N) and nitrate (NO₃-N). The Oculus system uses this data to control the Excell Aerator's power input and the Eliminat/R gate's position within the Carrousel system. Aeration power can be constantly adjusted to meet demand. This prevents over-aeration (which is detrimental to nutrient removal) and substantially reduces plant power bills.

Internal recycle from the aerobic zone to the anoxic zone is controlled in response to in-basin probes which account for diurnal fluctuations in influent flow and nitrate loading from other sources such as Return Activated Sludge (RAS) and digester decants. IR control is critical for bio-P plants, to prevent either a continuous or an intermittent flow of nitrate into the anaerobic zones.

Each Oculus System uses a touch screen operator interface and can be equipped with a modem for online monitoring and rapid access to Ovivo's industry-leading process support team.

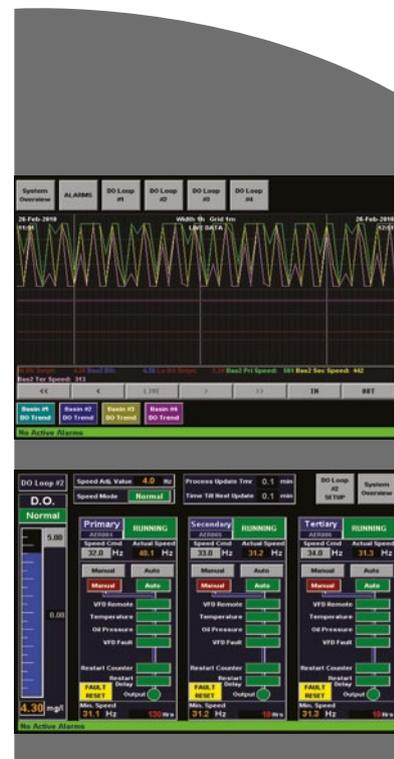
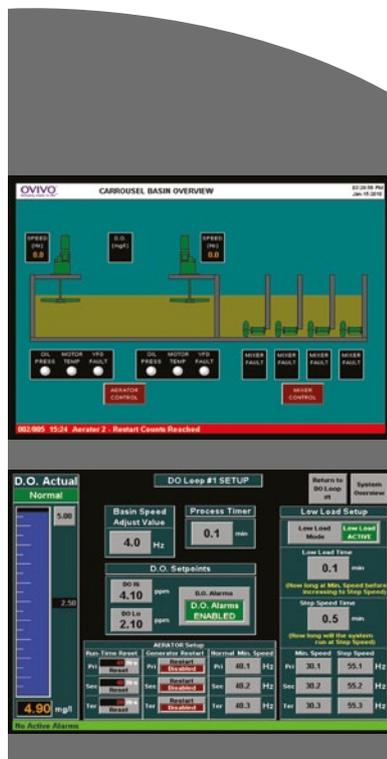
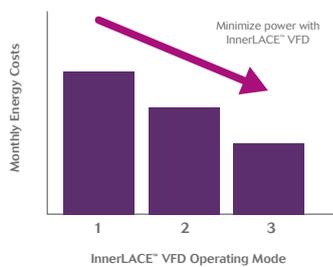


Potential energy savings



Optimizing IR (Internal Recycle) rate

Ovivo's new InnerLACE™ VFD is installed with every Excell® Aerator system, allowing you to track and make significant energy savings in aeration power input while meeting all process performance targets.



The Oculus™ touch screen operator interface varies Excell® Aerator power input and EliminatIR™ Gate position, minimizes power usage, maximizes nutrient removal, and displays useful trending data.

EWT™ Eliminat/R™ Gate and LM™ Mixer

EliminatIR™ Gate

The Eliminat/R™ Gate at the entry of the IR (Internal Recycle) channel incrementally opens and closes to control the flow of nitrate to the anoxic zone. The Excell Aerator generates sufficient channel velocity to provide free IR up to 15Q. The Eliminat/R Gate can also be automated for Storm Flow Mode.

LM™ Mixer

The Linear Motion (LM™) Mixer uses a unique hydro-disk design to create an oscillating liquid core. The LM Mixer's oscillating motion results in near isotropic (uniform) mixing. Producing only axial flow currents, the LM Mixer eliminates vortexing (typical of rotary mixers) and prevents cavitation: it does not entrain air in anoxic or anaerobic zones. Finally, the LM mixer uses between 50 and 80% less power than that required by submerged turbine mixers.

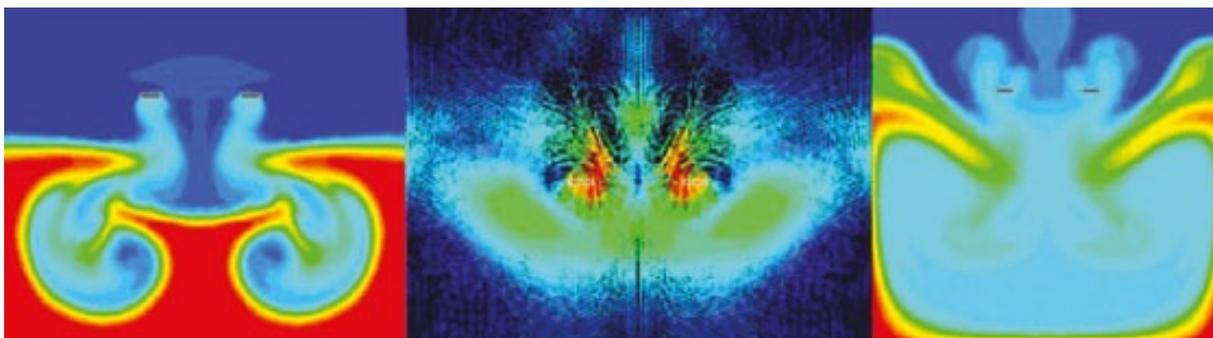
- Free IR to anoxic zones
- Consumes between 50 and 80% less power than submerged turbine mixers
- Efficient mixing in any tank geometry: no stagnant zones

Performance: LM™ Mixer vs. Industry Standards

Type of Mixing Equipment	Unit Power Rating	
	W/m ³	Hp/1000 cf
LM™ Mixer	1.32 – 2.63	0.05 – 0.10
Other mechanical mixing	5.23 – 10.53	0.20 – 0.40

The LM Mixer is easily adapted to tall tanks and can be retrofitted in existing roofs, covers and domes with center-mounted ports. The LM Mixer is applicable to anaerobic digesters and sludge holding tanks as well as anoxic zones for liquid processes with no need for multiple units or baffles in deep tanks.

Carrousel® is a registered trademark of DHV, B.V., the Netherlands.



Computational Fluid Dynamic (CFD) Modeling of LM™ Mixer

Ovivo remains dedicated to the advancement of Carrousel[®] process technology while maintaining the proven process simplicity, low maintenance, energy savings and equipment longevity well known to our customers.



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