



evoqua
WATER TECHNOLOGIES



BIOSPHERE[®] MOVING BED BIOLOGICAL SYSTEMS

**PROVEN FIXED-FILM TECHNOLOGY IDEAL FOR BNR UPGRADES AND
CAPACITY EXPANSIONS.**



SAME FOOTPRINT, BETTER TREATMENT AT NEPTUNE BEACH, FL WWTP

Without adding tank volume, a 0.9 MGD contact stabilization process for BOD removal was converted to a BioSphere® System to achieve < 3 mg/L total nitrogen discharge — an 80% reduction.

ENHANCED WASTEWATER TREATMENT THAT SAVES TIME, MONEY AND SPACE

BioSphere® Moving Bed Biological Systems are the latest innovation from Evoqua, a leader in fixed-film wastewater processes dating back to early rotating biological contactors from Envirex. BioSphere Biological Systems by Evoqua incorporate a newly designed biomass carrier into a moving bed fixed-film process that provides a protected, extremely high surface area environment for biofilm growth. The systems allow capacity increases of 200% or more and ensures compliance with ever-tightening permit limits — all within existing plant footprint.

BioSphere Biological Systems are ideal for plant upgrades, retrofits or expansions of both municipal and industrial wastewater treatment plants. The technology is cost effective and reliable. It can achieve BOD to < 5.0 mg/L, and total nitrogen (TN) enhanced nutrient performance of < 3.0 mg/L without adding tanks to an existing plant. The technology integrates into most existing activated sludge bioreactors, so project scope and duration is reduced. The small footprint required by the technology, and its ability to handle upset conditions also makes it a cost-effective, reliable solution for new plants.

Cover Photo: Nestled on Long Island Sound with no room for expansion, capacity at this 9.7 MGD water pollution control facility was increased by 76% while adding BNR treatment to achieve effluent total nitrogen of < 4.4 mg/L.

KEY BENEFITS OF BIOSPHERE® BIOLOGICAL SYSTEMS:

Cost Effective

Design and implementation efficiencies ensure lower capital and operating costs than conventional alternatives.

Small Footprint

High-rate treatment allows for a smaller footprint than conventional processes.

Flexible Design

The treatment system integrates into most activated sludge bioreactors. It can also be applied as a roughing filter for pretreatment or as a post-treatment polishing bioreactor.

Expandable

Simple media addition allows for easy plant expansion to accommodate population growth or other needs for capacity.

Stable Operation

Toxic upsets and hydraulic “wash out” events do not affect the entire microbial population in the biofilm, ensuring smooth and rapid system recovery.

Intensive and Low-Temperature Nitrification

A separate microbial population held on the biomass carriers enables quantitative nitrification even at a low sludge age. An autotroph rich biofilm allows stable nitrification, even at low temperatures.

Reliable Media Retention

Efficient use of non-clogging wedge wire screens ensure reliable retention of the biomass carriers in the bioreactor.

Durable

Heavy duty carriers can exceed 20-year life expectancy, even under intense bioreactor mixing conditions.



Side-by-side testing validates performance at 800 m²/m³ surface area.

INDUSTRY LEADING BIOSPHERE® BIOMASS CARRIERS ARE THE RESULT OF EXTENSIVE R&D

TECHNOLOGY, EXPERIENCE AND PROOF AT ITS CORE

At the heart of the BioSphere® Biological System is a patented carrier — the product of a comprehensive research and development effort. It is proven to provide 800 m²/m³ of protected surface area for biomass growth. Using 3D modeling, Evoqua determined the most efficient placement of partitions to maximize surface area while ensuring sufficient space for biological growth. This efficient use of material helps make the BioSphere Biological System carrier the lowest cost-per-surface-area solution on the market.

The BioSphere Moving Bed biomass carrier was subjected to a prolonged series of intense biological validation tests at a state-of-the-art Evoqua laboratory. Carbon oxidation, nitrification and denitrification tests were conducted to ensure media performance in a multitude of biological environments. The combination of 3D modeling and comprehensive validation testing has made the BioSphere Moving Bed biomass carriers an industry performance leader.

Evoqua offers biomass carriers tailored for specific treatment needs. BioSphere-N, for example, excels in ammonia removal applications.

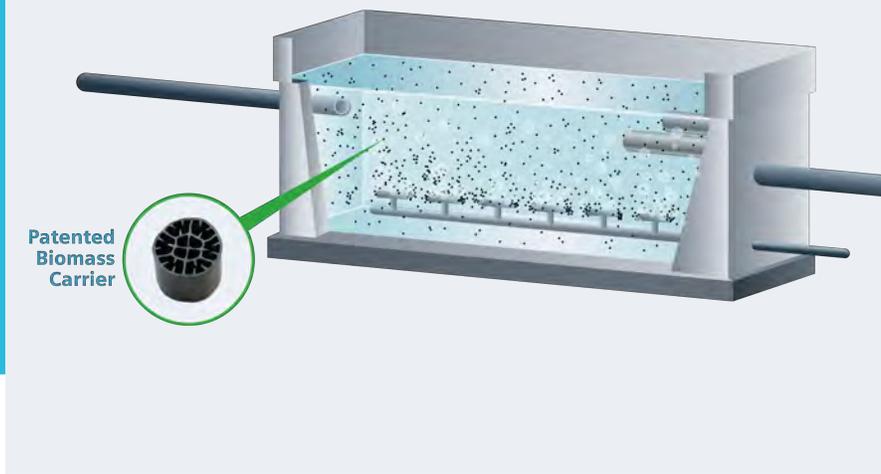
TWO BIOSPHERE® MOVING BED BIOMASS CARRIERS MEET APPLICATION SPECIFIC NEEDS

Model	 BioSphere	 BioSphere-N
Diameter	13 mm	13 mm
Length	5 - 9 mm	9 mm
Protected Surface Area	800 m ² /m ³	800 m ² /m ³

US patent numbers: D645,116 & D648,821



BioSphere® high surface biomass carriers are designed for performance.



BioSphere® Moving Bed Biological Reactor

EVOQUA KNOW-HOW TAILORED FOR SPECIFIC NEEDS

FLEXIBLE SOLUTIONS THAT IMPROVE EFFICIENCY

BioSphere® Moving Bed Biological Technology can be installed either as an integrated fixed-film activated sludge system (IFAS mode) or as a fixed-film system without activated sludge circulation (MBBR mode). Both systems utilize a unique spiral role aeration pattern that simultaneously mixes, transfers oxygen and sloughs off old biological growth.

In IFAS mode, RAS is returned to the bioreactor and the suspended biomass is combined with the fixed film biomass attached to the carriers. This mode of operation:

- Increases plant capacity without adding tanks or plant infrastructure
- Enhances biological nutrient removal in new or existing applications
- Is a cost-effective augmentation to an activated sludge process

In MBBR mode, the BioSphere Biological System uses a single pass configuration with no return activated sludge (RAS). This mode of operation:

- Reduces the suspended solids loading rate (SLR) on the clarifier
- Saves pumping energy by eliminating sludge recycle from the clarifier
- Increases the efficiency of BOD removal, roughing and pretreatment applications
- Is an effective lagoon system upgrade especially for ammonia removal

OXYGEN DELIVERY THAT HELPS OPERATORS BREATHE EASIER

The BioSphere Biological System utilizes unique spacing of the aerators to create a spiral role action of the biomass carriers. This rotation is important in sloughing old growth from the surface. The uplift and downlift action also ensures good mixing and oxygen transfer through the full depth of the tank. Evoqua aeration systems are compatible with both PVC and stainless steel and are available with self-sealing diffusers to minimize piping maintenance. For added peace of mind, aeration effectiveness is documented through the ASCE certified clean water oxygen transfer tests.

PILOT TESTING — OPTIMIZED TO MEET UNIQUE PLANT NEEDS

Not all wastewaters are the same, especially when it comes to industrial applications. Evoqua offers both bench scale and on-site pilot testing programs from its US and Singapore locations when needed to help tailor an optimal design.



Aeration system creates a unique biomass carrier spiral role action.



> 75% open screen area.

RELIABLE RETENTION STRATEGIES

Strategically-placed retention screens ensure all biomass carriers for the BioSphere® Biological System remain in their respective zones for the duration of the plant's life. Screens are available in cylindrical or flat models, depending on a facility's needs and utilize either a wedge wire or perforated plate design. Each screen has a minimum 7 mm opening allowing for smooth operation with the smallest number of screens, while also creating < 2" of head loss per stage. Screen supports are designed to withstand the buoyant forces of media and accommodate the full weight of media during draining. All supports are sized by Evoqua structural engineers and supplied as integral components of each customized system.

MULTIPLE CONFIGURATIONS FOR A BROAD ARRAY OF APPLICATIONS

BioSphere Moving Bed Biological Systems meet a wide range of wastewater treatment needs.

Nutrient Removal

The BioSphere Biological System in an IFAS configuration combines attached biofilm and activated sludge systems. It is specifically designed for:

Retrofitting existing plants for biological TN and total phosphorus (TP) removal

Increasing plant capacity and improving effluent quality

Existing Lagoons

Effluent quality of lagoon systems can be upgraded by adding the BioSphere Biological System as a polishing treatment. The result is an easy-to-operate, flexible and cost-effective solution that offers:

- Ammonia removal from lagoon effluents
- Lagoon effluent BOD polishing

BOD Removal

The BioSphere Biological System can be configured to achieve intensive BOD removal in a very short hydraulic retention time (HRT). This solution is best suited for:

- Increasing the BOD removal capacity of an existing plant
- Compact industrial and municipal plants

BOD and Ammonia Removal

For COD/BOD removal and nitrification without the use of activated sludge, the BioSphere Biological System offers a configuration solution based on fixed biofilm. Low bioreactor effluent suspended solids concentrations enable the use of dissolved air flotation (DAF) or filtration systems instead of clarifiers. This configuration, which reduces treatment plant space requirements, is especially suitable for:

- Industrial wastewater treatment
- New plants with area limitation and/or wastewater temperature < 10° C

FLWSHEET SOLUTIONS: TECHNOLOGY COMBINATIONS CREATE GREATER VALUE

Evoqua draws on its leading biological wastewater portfolio and applications experts to support projects where multiple technologies can be combined into high performing, lowest cost solutions. The BioSphere® Biological System, for example, can be combined with:

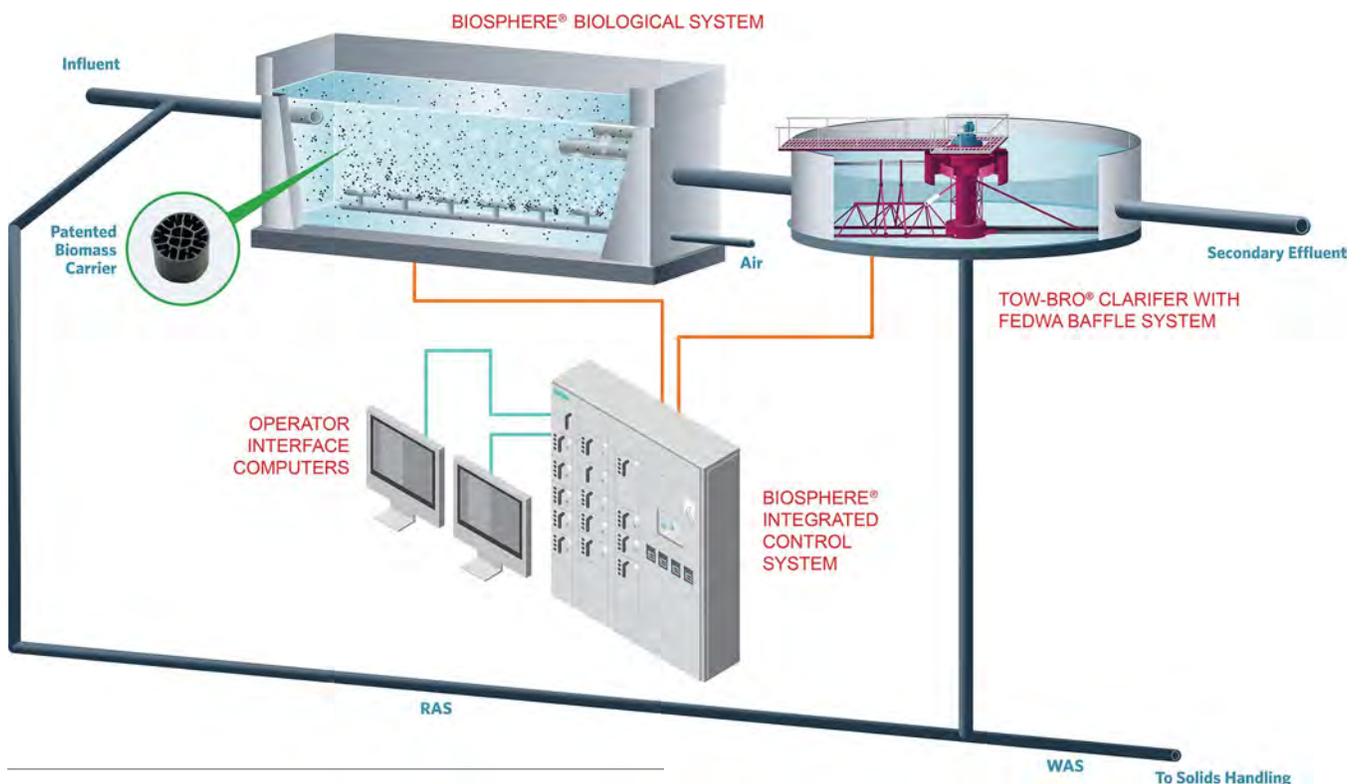
- Tow-Bro® high performance clarifiers to achieve stringent nutrient levels in an IFAS mode
- A Folded Flow® DAF for efficient, small footprint industrial applications
- The innovative CoMag® Magnetite Ballasted Treatment System to produce near MBR quality effluent in a small footprint
- TIW™ Control System Solutions that deliver seamless controls across technologies without costly redundancy.

Evoqua Flowsheet Solutions are supported with a dedicated single technical point of contact who assures coordinated, timely and accurate project execution, along with a comprehensive upfront evaluation of alternatives.

READY TO PUT THE TECHNOLOGY, EXPERIENCE AND EXPERTISE OF EVOQUA TO WORK?

Learn more about how the BioSphere Biological System can upgrade your plant's capacity and performance.

Visit www.evoqua.com/biosphere



Flowsheet Solutions from Evoqua provide expertise and project support across technologies.

ABOUT EVOQUA WATER TECHNOLOGIES

We have been providing leading technologies and know-how for over 100 years to help consulting engineers and municipalities clean and purify the world's most precious resource — our water. We excel in membrane treatment, disinfection, high rate clarification, biological processes, low energy biosolids solutions, odor control and seamless controls across process equipment. Our experts, experience, technologies and integrated approach make us one reliable source for the municipal water treatment needs of today and tomorrow.

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Carrier Designs are covered by Patents in the following countries:

Country	Patent Nos.
AU	336074 & 336353
CA	139762 & 139802
CN	3016873635 & 3020555895
EU	001837857 & 001838038
SG	D2011/407/C & D2011/409/F
US	D645,116 & D648,821

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