Conventional wastewater treatment plants require extended aeration times to meet effluent discharge regulations. They also produce significant volumes of low solids sludge that must be dewatered and disposed of at an additional high cost. These inherent design limitations increase the capital and operating costs of conventional systems making them very difficult and expensive to construct, operate or upgrade. The BIOSHAFT-MBBR and MAAD technologies provide unique solutions to these shortcomings while achieving superior and consistent effluent water quality that meet treated water discharge regulations.

BioShaft’s Containerized, Concrete, Bolted Steel and Fiberglass wastewater treatment systems and upgrades have been installed for various municipal and industrial applications in urban and remote locations around the world.
The BioShaft Moving Bed Bio Reactor (BIOSHAFT-MBBR) technology maintains a high concentration of biofilm within the structure of biomass carriers that are kept in motion in very low attrition surroundings inside a super aerated chamber. The resulting biomass content within the BIOSHAFT-MBBR system ranges from 15-30 kg/m³ compared to 2.5-4 kg/m³ maintained by conventional extended aeration systems. The stable biofilm accelerates the breakdown of organics, therefore allowing the BIOSHAFT-MBBR system to have up to double the capacity of an extended aeration plant with the same footprint.

The system also generates quick-settling colonies of sludge solids. The volume of the sludge removed from the clarifier in a BIOSHAFT-MBBR system is 80% less than the volume of the sludge removed from the clarifier in an extended aeration system. These very low sludge volumes reduce the need for onsite sludge dewatering, transportation and disposal costs. Combined with a lower power consumption, the operating cost of a BIOSHAFT-MBBR system is less than 50% of the operating cost of conventional wastewater treatment plants.

The system also provides superior nitrogen removal and far better odor control of both of the treated water and the low amounts of generated sludge. A BIOSHAFT-MBBR system does not require any special treatment chemicals, no scheduled chemical cleanings or expensive components to replace every few years.

The system is suited for small and large municipalities, remote communities, resorts and labor camps. It’s is also ideal for private sites like residential compounds, golf courses, parks and rest stops.
The Containerized System Standard Modules are standard 20 ft or 40 ft sea-freight shipping container designed and manufactured from scratch, not a new or used ISO shipping container conversion. They are configured as a complete packaged BIOSHAFT-MBBR wastewater treatment station. The Modules are single or multiple ‘Plumb, Plug, & Play Plants’ that are delivered within weeks to eliminate the high cost and long construction times associated with traditional civil works. The multiple Modules concept will be ideal to build new or upgrade existing plants reaching capacities exceeding half a million gallons per day. The containers occupy about half the footprint occupied by conventional treatment systems and produce around 80% less sludge volume that makes them more affordable to manage.

<table>
<thead>
<tr>
<th>Container Outside Dimensions</th>
<th>Model</th>
<th>Capacity (m³/day)</th>
<th>Capacity (GPD)</th>
<th>Eq. Pop.</th>
</tr>
</thead>
<tbody>
<tr>
<td>20'L x 8'W x 9'6”H</td>
<td>CS-050</td>
<td>50</td>
<td>13,000</td>
<td>250</td>
</tr>
<tr>
<td>40'L x 8'W x 9'6”H</td>
<td>CS-100</td>
<td>100</td>
<td>27,000</td>
<td>500</td>
</tr>
<tr>
<td>40'L x 8'W x 9'6”H</td>
<td>CS-150</td>
<td>150</td>
<td>40,000</td>
<td>750</td>
</tr>
<tr>
<td>40'L x 8'W x 11'6”H</td>
<td>CS-180</td>
<td>180</td>
<td>47,000</td>
<td>900</td>
</tr>
<tr>
<td>40'L x 8'W x 11'6”H</td>
<td>CS-250</td>
<td>250</td>
<td>66,000</td>
<td>1,250</td>
</tr>
</tbody>
</table>

Influent BOD & TSS: 250 & 250 mg/L, System Capacities will decrease if Wastewater temperature < 60 °F. Effluent BOD & TSS: < 10 & < 5 mg/L, System Capacities will decrease if Nutrient removal is requested. Standard Containerized BIOSHAFT-MBBR Systems can be upgraded to treat wastewaters with BOD up to 400 mg/L without any loss in system capacity.

Each engineered container comes with equalization pumps, a primary parabolic screen, an anoxic chamber, a dynamic aeration chamber, a bioreactor chamber with biomass carrier media, one clarification chamber with tube settlers, one upward flow tertiary filtration chamber, assembled internal plumbing and air diffusers, weirs, isolation and control valves. Two skid mounted air blowers and chlorination system. Also includes a skid mounted control panel, IP54, VFD and direct motor control, indication lights, switches, wiring terminated to control panel.
The Containerized Bioreactor Standard Module follows the same concept of the Containerized System Module but using the whole container as Bioreactor. These Modules can be easily plumbed to an existing or new Pre Aeration or Pre Anaerobic/Anoxic /Clarification basins for capacities ranging from 66,000 GPD up to 8 Million GPD reducing the footprint of the plant by 50% and offers the same benefits of the Containerized System Standard Modules. These modules are a good alternative when the elevations or the dimensions or the Pre Aeration or Anaerobic/Anoxic basins make it difficult to use the Submerged Bioreactors Standard Modules.

Please contact BioShaft to request a full proposal with complete design using the Bioreactors Modules.

<table>
<thead>
<tr>
<th>Container Outside Dimensions</th>
<th>Model</th>
<th>Capacity after upgrade (m³/day)</th>
<th>Capacity after upgrade (GPD)</th>
<th>Eq. Pop.</th>
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<tr>
<td>20'L x 8' W x 11' H</td>
<td>CR-250</td>
<td>250</td>
<td>66,000</td>
<td>1,250</td>
</tr>
<tr>
<td>40'L x 8' W x 11' H</td>
<td>CR-500</td>
<td>500</td>
<td>132,000</td>
<td>2,500</td>
</tr>
</tbody>
</table>

Influent BOD & TSS: 250 & 250 mg/L, System Capacities will decrease if Wastewater temperature < 60°F
Effluent BOD & TSS: < 20 & < 20 mg/L, System Capacities will decrease if Nutrient removal is requested.
Minimum Required Aeration Tank HRT after Bioreactor Upgrade- 6 hours.

Each engineered bioreactor container comes with attached growth chambers with reactor hood, top and bottom screen covers, membrane diffusers and biomass carriers; air saturation chambers with membrane diffusers; assembled internal plumbing; isolation and control valves; two skid mounted air blowers; skid mounted control panel, IP54, VFD and direct motor control, indication lights, switches, wiring terminated to control panel.
The Submerged Bioreactor Standard Module is self-standing, designed and manufactured to ship inside a standard open top shipping container. The Module is designed to be anchored to the walls of a new or existing plant’s concrete chambers. Custom designs using multiple Modules can be used for new or existing Wastewater Treatment Plants reducing the footprint of the plant by 50%, or if desired, double the existing plants capacity using the original planned footprint. Depending on the condition of the existing plant, the upgraded plant can obtain a significant percentage of the benefits mentioned on page 3 of this pamphlet. Please contact BioShaft to request a full proposal with complete design using the Bioreactors Modules.

### Submerged Reactor Standard Modules

<table>
<thead>
<tr>
<th>Ships inside open top Container</th>
<th>Model</th>
<th>Capacity after upgrade (m³/day)</th>
<th>Capacity after upgrade (GPD)</th>
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Influent BOD & TSS: 250 & 250 mg/L, System Capacities will decrease if Wastewater temperature < 60°F Effluent BOD & TSS: < 20 & < 20 mg/L, System Capacities will decrease if Nutrient removal is requested. Minimum Required Aeration Tank HRT after Bioreactor Upgrade - 6 hours.
The MAAD System integrates a compartmentalized tank with the BIOSHAFT-MBBR System. The first and last chambers of the tank are anoxic while the middle chambers are anaerobic. The tank maintains a thick blanket of anaerobic sludge that breaks down high strength organics and nutrients to more simple compounds for complete downstream removal by the BIOSHAFT-MBBR System. The compartmentalized tank also digests sludge generated by the rest of the system.

A municipal MAAD system installation occupies less than 40% of the footprint and consumes less than 50% of the power consumed by conventional municipal wastewater treatment systems. The system’s built-in sludge digestion mechanism reduces sludge volume generation by more than 95% compared to conventional systems. This eliminates the need for on-site sludge dewatering and regular offsite transportation and disposal, as the excess sludge need only to be removed once every few years. The operating cost of a typical municipal MAAD system is less than 50% of the operating cost of a conventional wastewater treatment system.

In industrial applications, the MAAD system digests fat, oils and grease making it possible to install a single integrated wastewater system without the need to install an upfront DAF system which is expensive to install, expensive to operate, requires highly skilled labor and still generates sludge that is expensive to dewater and dispose of.
The BIOSHAFT-MBBR process is superior to other biological wastewater treatment systems in many ways:

- More than double the capacity of a conventional wastewater treatment plant for the same footprint
- Lower capital, operating and maintenance costs
- 80% less sludge volume compared to conventional activated sludge systems.
- Minimal electromechanical components
- No coagulating or flocculating Chemicals
- No BIOSHAFT-MBBR bio reactor replacement costs
- Far better odor control
- High and reliable nutrient removal
- Superior BOD and TSS reduction

Modular overall design for phased installation or expansion
- Modular reactors can be added to existing systems to upgrade capacity, quality and to significantly reduce sludge production
- The MAAD system provides additional footprint, sludge and power consumption reduction benefits for municipal applications
- The MAAD system can treat mixed wastewaters from the food, beverage and dairy processing industries
- Underground installation, useful where land is at a premium cost, where no visual disturbance is required or where extreme temperatures exists

Standard and Custom Systems

Applications

Municipal:
New/Upgrades for City, Town, Residential/Commercial Buildings

Industrial
Slaughterhouse, Food Processing, Dairy

Satellite Plants
Private Developments, Resorts, Golf Courses, Rest Stops, Parks