Aquaculture

Bacteria Multiplier

BIO-Lair: High-Surface Area Porous Ceramic
BIO Media Products
Very Effective Bacteria Multiplier

High Surface Area = More Bacteria

✓ More surface than other substrates
✓ 7 times more bacteria in water
✓ Over 2,000,000 m²/m³ of surface area or 8,100 m³/Kg of media

<table>
<thead>
<tr>
<th>Pentair - Aquatic Ecosystems Catalog</th>
<th>Ship Weight</th>
<th>1 Kg BIO</th>
<th>1/4 Kg BIO</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Product</strong></td>
<td><strong>Description</strong></td>
<td><strong>M² / M³</strong></td>
<td><strong>Kg</strong></td>
</tr>
<tr>
<td>Spiorax</td>
<td>porous ceramic</td>
<td>268,990</td>
<td>0.5</td>
</tr>
<tr>
<td>BIO-FILL</td>
<td>shredded PVC ribbon</td>
<td>820</td>
<td>1.8</td>
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<tr>
<td>BIO-BALL</td>
<td>Plastic Ball Shape</td>
<td>321</td>
<td>5.4</td>
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<tr>
<td>BIO-BARREL</td>
<td>Polypropylene open barrel</td>
<td>210</td>
<td>2.7</td>
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<tr>
<td>BIO-STRATA</td>
<td>Black PVC sheets in block form</td>
<td>361</td>
<td>2.3</td>
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<tr>
<td><strong>Meta BIO Media</strong></td>
<td>BIO - porous ceramic (Ca,DN)</td>
<td>2,296,257</td>
<td>6.8</td>
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</tbody>
</table>
Aquaculture Plays Key Role in Supplying Food in World

- Over 158 million Tonnes of Fish, Shrimp, etc. Consumed
- 84% Raised in Asia – Mostly in China (>60%)
- Growing Economic Production Needed to Meet Demand
- Disease Threatens Growth – Healthier Water Needed

More Bacteria Grow on BIO-Lair Media
Aquaculture

- Enhance Nature’s way to remove wastes (Microorganism are natures original recycler)
- For high density aquaculture
  Improved ways to control water quality needed
- Major Wastes
  - Residual food and fecal matter
  - Metabolic by-products
  - Residues of biocides and biostats
  - Wastes produced during moulting
  - Collapsing algal booms
- Bioremediation – when micro and macro living organism are used to maintain water quality
- Bacterial flocs are also consumed by fish
Aquaculture

Successful Bioremediation

- Keep Ammonia & Nitrite low (below 0.5 mg/L)
- Enhance denitrification to convert nitrate to nitrogen gas
- Maximize sulfide oxidation to reduce H2S accumulation
- Maximize carbon oxidation to CO2, to minimize sludge
- Improve productivity (faster growth, lower mortality) – with improved water quality
- Fight diseases – lower use of antibiotics – use probiotics
- Control undesirable species
Working Together

- Special Aquaculture Blends of Bacteria provide proven microbial and probiotic water treatment
  - Strong, Fast Growing Bacteria Lowers Ammonia
  - Enzymatic Bacteria Break Down Proteins, Oils, Organics
  - Probiotic Bacteria Strengthen Digestive Track of Fish & Shrimp to Fight Diseases

- BIO-Lair Porous Ceramics
  - Sustains High Concentration of Bacteria Colonies.
  - Increases Bacteria Concentration by 5 times and more

BIO-Lair speeds up Nature’s way for removing waste products from water without chemicals
**Why Does This Work**

- **Bacteria Blends Designed for Aquaculture**
  - Active Colonizable Units (>100 million CFU)
  - Environmentally Safe Formula
  - Enzymes to catalyze breakdown complex organics
  - Probiotic Bacteria to help fight diseases

- **High Surface Area of Media** – Over 8,000 m³/Kg
  - 1 Kg has surface equal to 700 Kg of plastic media
  - Sustains bacteria in the water above 15,000 mg/L
    6 times higher than norm of 2,500 mg/L
  - Holds weight in water – protects bacteria out of water
  - Only 15-25 Kilo per Hectare needed
Bioremediation of Carbonaceous Waste

- Microbes that multiply rapidly and have good enzymatic capability
  - Members of genus *Bacillus* and *Phenibacillus*
  - Produces variety of enzymes that break down protein and starch to small molecules, which are taken up as energy sources by other organisms
  - Higher amounts not normally present in water column – natural habitat is in sediment
  - Bio-Lair provides huge surface for microbes to grow rapidly and increases their presence in water columns significantly
  - Competes with bacterial flora naturally presents – out completes and removes cyanobacteria (blue green algae)
  - Reduces water turbidity and reduces use of mechanical filtration and water change.
Removal of Nitrogenous Compounds

Bio-Lair provides simultaneous oxidation of ammonia and nitrites and reduce nitrates in Anaerobic Zones created inside Bio-Lair while Aerobic Zones exist near the product surface.

- **Ammonia Sources**
  - Fish excretion
  - Mineralization of organics
  - From reduced sentiment

- **Ammonia oxidizers** – *Nitrpsomonas, Nitrovibrio, Nitrococcus, Nitrobus* and *Nitrospira*

- **Nitrite oxidizers** – *Nitrobacter, Nitococcus* and *Nitrosphra*

- **Nitrate reducers** – *Pseudomonas, Bacillus* and *Alkaligenes*

- **Bacteria need substrates** for high bacteria density growth
BIO-Lair Substrates for Nitrifiers

- Nitrifiers can survive and grow in water without attachment to a solid surface.
- High surface area of Bio-Lair media promotes the highest density of nitrifiers.
- Bacteria will thrive and proliferate due to aggregation on solid surfaces available.
- Inorganic ions are attracted to the surface of bio-films and surfaces of the media promoting greater nitrification rates and improved water quality.
Synergy of Combination of Bio-Lair & Bacteria

- **Faster Growth** of fish or shrimp – more kilo’s/cycle
- **Higher Yields** per liter of water – more kilos produced
- **Lower Feed** conversion ratios – reduces cost for high protein feed and need for medicated feed
- **Healthy Water** – Less Stress of Creatures & fewer pollutants to affect Water Quality or Growth Rate
- **Quick Payback** of investment – make more money on any basis. Payback can occur in 1-2 growing cycles
Control Harmful Algae Blooms

- **Cyanobacteria Blooms Cause Problems**
  - Microcystin toxins excreted - harmful to humans and animals
  - Flavor in fish and shrimp affected by excreted contaminants
  - Eutrophication – lowers oxygen in water – fish die

- **Nutrients too High - particularly phosphorus**

- **Reduce Cyanobacteria with Bacteria**
  - Breakdown Cyanobacteria Filaments with Bacteria
  - Sustain Bacteria Concentrations to prevent forming

- **High Bacteria lowers phosphorus in water**