Meta Materia
Environmental NanoTechnology

Aquaculture

Bacteria Multiplier

BIO-Lair: High-Surface Area Porous Ceramic

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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 m^2/m^3 of surface area or 8,100 m^3/Kg of media*

					Comparision	
Pentair - Aquatic Ecosystems Catalog			**Ship Weight**		**1 Kg BIO**	**1/4 Kg BIO**
Product	**Description**	**M^2 / M^3**	**Kg**	**M^2 / Kg**	**Kg Needed**	
Spiorax	porous ceramic	268,990	0.5	21	14	3.5
BIO-FILL	shredded PVC ribbon	820	1.8	13	640	160.0
BIO-BALL	Plastic Ball Shape	321	5.4	2	4898	1224
BIO-BARREL	Polyproplene open barrel	210	2.7	2	3750	938
BIO-STRATA	Black PVC sheets in block form	361	2.3	18	455	114
Meta BIO Media	BIO - porous ceramic (Ca,DN)	2,296,257	6.8	8,192		
			1.7	2,048		

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***

Improve the water and creatures grow faster, are healthier, and less food is wasted

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

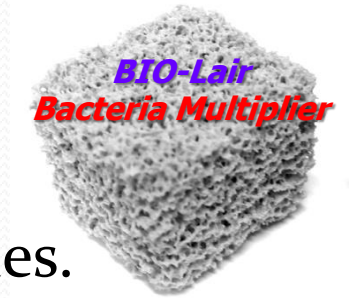
Successful Bioremediation

- 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 m^3/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, Nitrococus,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**