Pompano Culture in Recirculating Aquaculture Systems

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Funding Thanks to

CDFA 11.417: Wills - Final Steps Toward Commercialization of Pompano Aquaculture
NA18OAR4170345
Recirculating Aquaculture Systems (RAS)

- Year round growing season
- Reduced water consumption
- Reduced effluent discharge
- Intensive production
- Enhanced biosecurity
- Increased food safety
- Containment of escapees
- Environmental Sustainability
Basic RAS Design

- Waste Water & Evaporation
- Makeup Water
- Oxygen
- Nitrate (very low toxicity)

- Feed
- Solid and Dissolved wastes

Solids Filtration

- Ammonia (Highly Toxic)

Biofiltration

Concentrated Waste Sludge
Advanced RAS design and Operation

“The Yellow Book”

New 5\textsuperscript{th} edition

Available on Amazon $99

Search “ISBN 0971264694”
Basis of the Commercial System Design

• Scaled up version of tested design developed jointly for USDA-ARS project and FL-FWCC marine hatchery program FMFEI

• System Operated so far with:
  – Red Drum up to >90 Kg/m³ \(\rightarrow\) (~1% BWD feed rate)
  – Florida Pompano ~40 Kg/m³
  – Cobia ~45 Kg/m³
1. Long flow pathway moving bed reactor with cross flow oxygenator, float valves, and propeller pump; 2. Incoming salt and freshwater lines with float valves and water meters; 3. UV sterilizer; 4. Torrus filters with 13ft³ of MB3 floating plastic media; 5. Ten-foot diameter tanks w/ center sump and sidebox drain; 6. Diverter box; and 7. 60 micron drum filter.
BIOFILTER VOLUMETRIC NITRIFICATION RATES

Long Flow Pathway Moving Bed Biofilter

Influent TAN (mg/L)

g TAN/m³ media-day
Commercial System Design

Culture Tank
20,230 gallons
25 ft diameter 6 ft deep
6 inches free board

Pump Basin

Foam Fractionator

Solar Panel

UV Filter

Static Bed Filters

Moving Bed Biofilter
250 ft³ of MB³ biomedia

Drum Screen Filter 40 µm

Overflow Bypass

* Static Bed filters each contain 8 ft³ of MB³ biomedia

* Not to scale

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www.hboi.fau.edu
Panorama of Filtration System

Return Water

Foam Fractionator

Main Pumps

Biofilter Drum Screen Filter

Pumping Basin

Static Bed Filters

Ultraviolet filters
Drum Screen Filter (60um)
Microscreen Cleaning Process
Waste Water Recapture

- We used a Static Bed Filter to separate solids from Drum Screen Filter Waste stream
  - Concentrates solids prior to discharge
  - Recaptures significant component of water used for wash down of drum screen
  - Each contains 8 Ft$^3$ MB$^3$ Media
Moving Bed Biofilter
(450 ft³ MB³ Biomedia)

Aeration Keeps Bed Fluidized
Minimum Dose Desired

30,000 uW sec/cm$^2$

The two units delivering

$\sim$150,000 uW sec/cm$^2$
Tank Cover
Aeration and Oxygenation

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Aeration and Oxygenation

Oxygenation Zone 1

Oxygenation Zone 2

Aeration Zone

25 ft Diameter

O₂ Sensors
Backup Systems

• Systems designed to combat “Murphys Law”
  – “If anything can go wrong it will”

• Therefore managers must:
  – Anticipate
  – Plan
  – Train
  – Respond

• (an automatic system that “cries wolf” can derail this necessary task)
Backup Systems

- Generators
- Automatic oxygen system
- Alarm Systems
Generators

- Must have disconnect switch and meet other local requirements
Automatic Oxygen System

• Opens oxygen flow to tanks regardless of monitoring systems or other backup systems when power lost

• Must use Normally Open Solenoid Valves for failsafe system
  – Normally open ➔ closed when power on; open when power off
Nursery System
Larviculture System
Broodstock Conditioning and Spawning System
USDA-ARS/HBOI-FAU Design
Florida Pompano
Weight: 0.7 – 2.3 kg
Mature age: 1 - 3 yrs
Temp: 18 – 30 C
Salinity: 5 – 36 ppt
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Target Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature</td>
<td>16 – 30 C</td>
</tr>
<tr>
<td>pH</td>
<td>7.6 – 8.2</td>
</tr>
<tr>
<td>Dissolved oxygen</td>
<td>≥ 5 mg/L</td>
</tr>
<tr>
<td>Alkalinity</td>
<td>≥ 200 mg/L</td>
</tr>
<tr>
<td>Ammonia</td>
<td>≤ 1 mg/L</td>
</tr>
<tr>
<td>Nitrite</td>
<td>≤ 2 mg/L</td>
</tr>
<tr>
<td>Total dissolved solids</td>
<td>≤ 5 mg/L</td>
</tr>
</tbody>
</table>
**Broodstock Conditioning System**

- **Culture Unit** (5.7 m³)
- **Egg Collectors** (0.3 m³)
- **Sump** (2.3 m³)
- **Cartridge filters**
- **Pump to chiller**
- **Return from chiller**
- **Beadfilter** (0.1 m³)

Waste flows through the system, and waste is directed to the Beadfilter.