Recirculating Aquaculture Systems

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First Question: What Do You Want to Do?

1) What are your water quality objectives?
2) What are your economic objectives?
3) Water supply & disposal?
4) Feed application rates?
Biofiltration

Oxygenation

Solids removal
Solids removal
Oxygenation
• **Five Major Processes**

1) Circulation (Solids capture)
2) Clarification (BOD reduction/nitrification)
3) Biofiltration (BOD reduction/nitrification)
4) Aeration (Oxygen replacement)
5) Degasification (CO2 stripping)
• **Minor Processes**
  1. Alkalinity control
  2. Foam control
  3. Disinfection
  4. Denitrification
  5. Color Control
### Warmwater Growout Criteria

(Malone and DeLosReyes, 1997)

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Specification</th>
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<tbody>
<tr>
<td>Tank Volume</td>
<td>200 gal / lb-feed-day</td>
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<tr>
<td>Bead Filter</td>
<td>1 ft³ / lb-feed-day</td>
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<tr>
<td>Water Pump</td>
<td>6 gpm / lb-feed-day</td>
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<tr>
<td>Aerator / Airstones</td>
<td>3 cfm / lb-feed-day</td>
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<tr>
<td>Bicarbonate</td>
<td>0.24 lb / lb-feed-day</td>
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<tr>
<td>Flushing</td>
<td>8 gal / lb-feed-day</td>
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Design Objectives

• Size treatment technologies to support designated fish load
• Identify cost effective combinations
• Assure long term reliability
Design Modifiers

- Species cultured
- Temperature
- Type of feed (% protein)
Feed Rate

Feedrate = (Capacity)(Daily feed ration)

- Controls sizing of treatment units
- Percent protein impacts ammonia generation
• Trickling filter
  – BOD reduction
  – Nitrification
  – Aeration
  – CO2 stripping
Natural Candidates

- Airlift Pumps
  - Circulation
  - Aeration
  - CO2 stripping
More candidates.....

- Rotating Biological Contactor
  - BOD reduction
  - Nitrification
  - Aeration
  - CO2 stripping

- Anaerobic
- Fluidized Bed
  - Denitrification
  - Alkalinity Replenishment

- Foam Fractionator
  - Foam control
  - Aeration
  - Carbon dioxide Stripping
  - Fine solids control