High Intensive RAS for eels culture

Recirculation Aquaculture System

( Anguilla japonica & Anguilla bicolor )

FISHVIL CO., LTD
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1. Type of eel culture farm
2. How the *A. japonica* RAS process was initiated and settled
3. The basic theory of establishing the system
4. The RAS process for *A. japonica*
5. Advantage and disadvantage of RAS for *A. japonica*
6. Future direction of eel culture
7. The video clips and pictures for RAS in Korea
1. The type of eel culture farm

- **Pond Type**
- **Cement Tank Type**
- **Simple RAS Type**
- **High intensive RAS Type**
1. The type of eel culture farm

1.1 Pond Type

- It is partially successful in China, Taiwan, Indonesia, Vietnam and other Southeast countries.
- It has low density per unit area and difficult to be managed and planned.
- Investment cost in the facilities is cheap.
- It is required a lot of land and high temperature throughout the year.
- Production density: 0.5-0.7kg/m², Production period: 12-18 months.
1. The type of eel culture farm

1.2 Cement Tank Type

- The traditional type of Japonica eels culture type in Japan, Taiwan, Korea, and China is cement type
- It has been very common aquaculture type in Japan until now
- It is difficult to raise various species of eels (*A. bicolor* and *A. rostrata*)
- Production density: 15kg/m², Production period: 8-16 months.
1.3 Simple RAS Type

- It is converted from general cement tank-type.
- It uses the existing facilities, the installing process is simple.
- Does not have a biological filtration tank.
- It equipped with drum screen, oxygen liquefier, UV sterilizer.
- Production density: 25-30kg/m², Production period: 7 months
1. The type of eel culture farm

1.4 High Intensive RAS Type

- Developed by the traditional RAS in Europe
- Transformed to meet the culture specifications for *A. japonica*
- Possible to various eels species
- Production density: 150-180kg/m²
- Production period: 5.5-10 month/250g
2. Initiated & settled process for *A. japonica* RAS

1. **1st step**
   - 1990~1996
   - Beginning stage

2. **2nd step**
   - 1996~2000
   - System process

3. **3rd step**
   - 2000~2004
   - Settle down after and failure

4. **4th step**
   - 2004~
   - Success and stabilization
2. Initiated & settled process for *A. japonica* RAS

2.1 1st Stage: Early stage

- RAS aquaculture was recognized and studied only as needed and very sometimes applied to the field.
2. Initiated & settled process for *A. japonica* RAS

2.2 2\(^{nd}\) Stage: Getting into process stage

- **Modern RAS system was getting into process and facilitated in Korea.**
  - Introduced European RAS for *A. anguilla* eels farm
  - Began to configure Other system. (Aquaculture Tank, Filter media...)
  - System modified according to the characteristics of Korean style
  - Introduction of Industrial RAS (1998)
SYSTEM PROCESS
2. Initiated & settled process for A. japonica RAS

2.3 3rd Stage: Failure and settled process.

- Unfortunately it was not successful to adopt this European system.
- The system began to build a system to meet the characteristics of A. japonica.

◆ Cause of the failure..

<table>
<thead>
<tr>
<th>A. anguilla</th>
<th>Production Period</th>
<th>Water temperature</th>
<th>Types of feed</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 month</td>
<td></td>
<td>24~26°C</td>
<td>Floating pellet feed</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>A. japonica</th>
<th></th>
<th>28~30°C</th>
<th>Dough power feed</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 month</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

It was resulted in ignoring every problem caused by specific aquaculture environment and the detail amount of pollutant loads.
2. The initiated & settled process for *A. japonica* RAS

2.4 4th Stage: Success and stabilization phase

- **Switch to the *A. japonica* matching system.**
  - Increase in volume of the filtration tank
  - Increase the time of circulating water
  - Overcome that many death eels during the period of water stabilization.

- **Increased production per area and shorten the production period**

  - **Early stage**
    - 100kg/m²
    - 8 month/250g
  - **Middle stage**
    - 150kg/m²
    - 7 month/250g
  - **Now**
    - 180kg/m²
    - 5.5 month/250g
3. The Basic Theory of establishing the system

3.1 Nitrogen cycle

Feeding 1Kg

Heterotrophic Bacteria

Produced 400g SLUDGE

Produced 30g Ammonia

Nitrosomonas Bacteria

Consumption 137g O$_2$

Consumption 214g Alkalinity

Produced 180g CO$_2$

Produced 132g Nitrate

Nitrobactor Bacteria

Nitrite

Nitrate
2. Basic Theory

2.2 Nitrogen Compounds

Inorganic Nitrogen Compounds

- **NH₃–N** (un-ionized ammonia nitrogen)
- **NO₂–N** (nitrite nitrogen)
- **NO₃–N** (nitrate nitrogen)
- **NH₄⁺-N** (ionized ammonia nitrogen)

\[
\begin{align*}
\text{NH}_4^+ + 1.83 \text{O}_2 + 1.97 \text{HCO}_3^- & \rightarrow \\
0.0244 \text{C}_5\text{H}_7\text{O}_2\text{N} + 0.976 \text{NO}_3^- + 2.90 \text{H}_2\text{O} + 1.86 \text{CO}_2
\end{align*}
\]
2. Basic Theory

2.3 The curve nitrogen compound change
4. The system process

- **Aquaculture Tank**
- **Water Control Tank**
- **Cleaner**
- **Drum screen**
- **Fixed Filter Tank**
- **Fluidized Filter Tank**
- **Ammonia Nitrite**
- **Temp. DO, pH**
- **Dead eels**

**Process Flow**:
- **One circulate per 1hr**
- **SLUDGE (70%)**
- **SLUDGE (30%)**
1. The type of eel culture farm

1.4 High Intensive RAS Type
4. The system process

4.1 Aquaculture Tank

- Low manufacturing cost.
- Available to manufacture into various size and shapes.
- P.P material which is not harmful to fishes and human body.
- It is durable but not fragile! (Use over 20 years)
PP Tank
PP Tank
4. The system process

4.2 Cleaner

Plays the role of inhaling the sludge accumulated in the center of aquaculture tank and sending the inhaled sludge to the processing unit.

- Prevents the water from being spoiled by immediately removing the dead eels.

- Removes the bubble floating on the water surface.
CLEANER
CLEANER
4. The system process

4.3 Drum screen

- Plays the role of removing the solid and separating the removed solid from the breeding water.
- Plays the role of constraining the occurrence of ammonia and nitrous acid.
- Plays the role of reducing the load in the pollutant organism.
Drum-screen
Drum-screen
Drum-screen
4. The system process

4.4 Fixed filter tank

- Material: POLYVINYLIDENE CHLORIDE FIBER

There are lots of voids on the contact agent to allow the microbe to well inhabit.

▷ Aerobic and basic microorganisms are grown by being well harmonized.
▷ Bigger contacting area as compared with other contact agents.
▷ Don't worry about how to treat the residual sludge.
Fixed Media

Before

After
4. The system process

4.5 Fluidized filter tank

- Performs by flowing and floating the filter media.
- Maximizes the function to remove ammonia and nitrite.
Fluidized media
Fluidized media
4. The system process

4.6 Water quality control tank
Another equipment
Another equipment
4. The system process

4.7 Monitoring system

**Monitoring**
- Real-time monitoring at office, online, through mobile phone, and surveillance camera on the information from the automatic measure on DO, temperature, pH, and water level.
- Real-time monitoring even when you are away on domestic and overseas business trip.

**Alarming**
- Alarm system on the malfunction of controlling water quality (DO, temperature, pH, water level) and other important system and reported to Office, field, and through mobile phone.

**Automation**
- DO: auto ON/OFF control according to the programmed DO concentration.
- Temp.: auto ON/OFF control according to the programmed temperature.
- pH: auto supply control according to the programmed pH concentration.
- Water level: auto water level control according to the programmed water level.
Monitoring

- **Temperature**: 14.62°C
- **Conductivity**: 42.77 mS/cm
- **Salinity**: 27.53 ppt
- **pH**: 7.79
5. Features of RAS for *A. japonica*

5.1 Advantage

- **Increased productivity**
  - Dead rate: less than 3%
  - (A lot more production per unit area)
    - 180kg / m²

- **Shortened production period**
  - 5.5 month / 250g

- **Excellent in the Production cost**
  - USD 7 /kg:
    - (exception cost of glass eels)
5. Features of RAS for A japonica

5.1 Advantage
5. Features of RAS for *A. japonica*

### 5.2 Disadvantage

- **RAS For *A. japonica***
  - (Expensive construction Costs)
  - (Accident responding time is short)
  - (Management & operation expertise is required)
5. Features of RAS for *A. japonica*

### 5.3 Comparison

<table>
<thead>
<tr>
<th>Feature</th>
<th>RAS</th>
<th>Cement Tank</th>
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</thead>
<tbody>
<tr>
<td>Production capacity (1m²)</td>
<td>180 Kg</td>
<td>15 Kg</td>
</tr>
<tr>
<td>Production period (Month)</td>
<td>5.5 Month</td>
<td>8 Month</td>
</tr>
<tr>
<td>Productivity (Glass eel 1kg)</td>
<td>1,485 Kg</td>
<td>900 kg</td>
</tr>
</tbody>
</table>
6. Future direction of eel culture

6.1 Glass eel of *A. japonica* reduced

1) Price increase on glass eel
2) Sales price increase on eels
3) Reduction in consumption
4) Shut down of farm business
5) Try different types of eel aquaculture
6) Failures due to lack of technology on various species
7) Concerns the waste of resources, and the influx of other pathogens.
Various types of eel culture mentioned above in South Korea, Japan and China causes

1) Initial massive perishment of glass eel due to stress by the long transportation

2) The long period of high water temperature for farming.

3) Gill parasites infection makes it difficult to farm in the Far Eastern region.

6. Future direction of eel culture

6.2 Cause the failure *A. Bicolor* culture.
6. Future direction of eel culture

6.3 Future direction of eel culture

1) Constriction of eel culture system which can raise any kinds of eels.

2) Constriction of eel culture system which can be suitable in each country and region.

3) Local eel culture in the catching area.
7. Video & photo

7.2 Video clip for *A. bicolor* culture
Thank you !!

Q & A