Langsand Salmon & RAS Design Innovations and Opportunities for New Technologies

By Bjarne Hald Olsen, CEO of Billund Aquaculture
Agenda:

1. Who are Billund Aquaculture
2. Langsand Salmon
3. RAS Design Innovations and Opportunities for New Technologies
Billund Aquaculture

- Billund Aquaculture is a Danish company located in Billund, Denmark and in addition we have offices in Norway and Chile. Totally we are 68 employees all around the world.

- We have a large and well documented reference list which document more than 27 years of experience in design, installations, operation and service of intensive re-circulation fish farms.

- Worldwide Billund Aquaculture has so far build more than 114 re-circulated systems for 24 different salt- and freshwater species in 25 different countries.

- The practical know-how has been obtained through our own production facilities, where we since 1984 have produced eels, sturgeons and sea bream/sea bass in our own hatcheries- and production systems. In addition this also serve as test facilities to improve research and development.

Billund Aquaculture offer the following services:

- Project development from idea to turn key realisation
- Feasibility study
- Project proposal and preparation
- Biological design
- Engineering design
- Drawings
- Construction and implementation of the fish farm
- Start-up procedures and supply of customized operational and management manuals
- Training, education and management support of the staff at all levels
- 24 hours hot-line and ongoing know-how availability
Billund Aquaculture

Examples of RAS
Examples of what Billund Aquaculture can supply:

Landbased Salmon-smolt facility for Lerøy Seafood (Lerøy Midnor) in Norway
Capacity: 14–18 million smolt per year – 11,000 m² under roof – Total biofilter capacity 8 tons/day
Examples of what Billund Aquaculture can supply:

Landbased Salmon-smolt facility for Lerøy Seafood Group in Trondheim, Norway
Capacity: 14–18 million smolt per year – 11,000 m² under roof – Total biofilter capacity 8 tons/day
Examples of what Billund Aquaculture can supply:

Aquatir – Moldova – www.aquatir.md

Beluga

Russian sturgeon

Sterlet

Bester
Examples of what Billund Aquaculture can supply:

Aquatir Facility in Moldova - Lay-out

Total area: ~ 30,000 m²
Examples of what Billund Aquaculture can supply:

Sturgeon Facility: Live Feed-, Incubation-, Hatchery-, Startfeeding-, Juvenile-, and Broodstock Units
Examples of what Billund Aquaculture can supply:

Sturgeon Facility: 2 On-Growing Units
Examples of what Billund Aquaculture can supply:

Sturgeon Facility in Moldova, Sheriff – Broodstock Unit 1 of 3
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Examples of what Billund Aquaculture can supply:

Sturgeon Facility in Moldova – Some of the products
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Langsand Salmon - A RAS for a yearly production of 1,000 tons 4-5 kg salmon:

Location:
In a town called “Hvide Sande” in Denmark located in the center of Scandinavia
Conducted two Grow-Out test for Salmo Salar in our own RAS

Focused on the following issues:

- Handling & Logistic
- Fish densities versus fish size
- Fish densities versus tanks size
- Growth rates
- Feed Conversion Rates (FCR)
- Temperature regimes
- Salinities
- Feed composition
- Maturation (light, temperature etc.)
- Off-flavor
- Fish quality (condition, fillet yield etc.)

Background for the project:

Billund Aquaculture has been working with Grow-Out concept for the last 5 years

Conducted two Grow-Out test for Salmo Salar in our own RAS

On the following dias, the “Langsand Salmon” project will be presented........
Langsand Salmon - A RAS for a yearly production of 1.000 tons 4-5 kg salmon:

Owners:  
Atlantic Sapphire, a former organic Salmon farming company - 25%  
Steensgaard Holding, owner of Billund Aquaculture - 20%  
Polar Salmon, a Salmon processor - 20%  
Langsand Dambrug, a former Trout and Eel farmer - 20%  
AquaPri, a Trout and Pike perch farming company - 15%

Production capacity:  
• Yearly production of 1.000 tons 4-5 kg salmon, can be increased to 4.000 tons.  
• 4 batches per year  
• First hatch July 2011 – First harvest Q3 2013
Langsand Salmon - A RAS for a yearly production of 1,000 tons 4-5 kg salmon:

- Before an Eel-farm based on RAS and a Trout-farm based on flow-through was located in the area.
- The Eel-farm are now being used as Hatchery and Smolt Production.
- The Trout-farm has been demolished and the Salmon Production has been established using the existing permits for discharge.
Langsand Salmon - A RAS for a yearly production of 1,000 tons 4-5 kg salmon:
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All building established on top of the ground.
Langsand Salmon - A RAS for a yearly production of 1,000 tons 4-5 kg salmon:

Dimension criteria:

Total building area:
- Incubation, Hatchery, Parr and Smolt-system: ~ 700 m²
- On-Growing system: ~ 3,300 m² (120 m x 27,5 m)
- 4,000 m² ~ 4 m²/ton produced salmon

On-Growing System:

Total tank volume: 6,100 m³
- 4 pcs. Ø 7,8 m – water level 5,5 m – 260 m³ (off flavour)
- 4 pcs. Ø 8,5 m – water level 4,6 m – 260 m³
- 3 pcs. Ø 10,2 m – water level 5,5 m – 450 m³
- 3 pcs. Ø 14,2 m – water level 5,5 m – 870 m³
Langsand Salmon - A RAS for a yearly production of 1,000 tons 4-5 kg salmon:

On-Growing system: Water flow through the system:
Langsand Salmon - A RAS for a yearly production of 1,000 tons 4-5 kg salmon:

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Langsand Salmon - A RAS for a yearly production of 1,000 tons 4-5 kg salmon:

On-Growing system: Water flow through the system:
Langsand Salmon - A RAS for a yearly production of 1,000 tons 4-5 kg salmon:

Production flow per batch (4 batches per year):

- **Smolt System**
  - Ø8,5m tank
    - Max 85 kg/m³
    - 4 months
  - Ø10,2m tank
    - Max 85 kg/m³
    - 3 months
  - Ø14,2m tank
    - Max 100 kg/m³
    - 3 months

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- **From hatching to harvest 20 to 22 months**

- 1 week to 4 weeks (off flavoring takes one week without feeding)

First hatch July 2011 – First harvest Q3 2013 (4-5 kg salmon)
Langsand Salmon - A RAS for a yearly production of 1.000 tons 4-5 kg salmon:

Dimension criteria and resource consumption:

On-Growing system: (input: approx. 210 gram, output 4-5 kg salmon):

- Water flow to fish tanks: 7.400 m³/h equal 48 minutes of retention time
- Biological filter capacity (maximum): 3.000 kg feed per day
- FCR: 0,95
- Water consumption: 250 litre water per kg feed applied to the system
- Oxygen consumption: 0,5 kg oxygen/kg produced salmon
- Lime consumption: 0,1 kg Ca(OH)₂/kg produced salmon
- Coagulant & Polymer: 100 ml/litre sludgewater & 3 gram polymer per kg DM
- Energy consumption:
  - Main pumps to fish tanks: 1,05 kW/prod. salmon
  - Mechanical filters, various pumps etc.: 0,25 kW/prod. salmon
  - Cooling/heating, ventilation, wells, light, phosphor removal, de-nitrification etc: 0,95 kW/kg prod. salmon
  - GRAND TOTAL: 2,25 kW/kg produced salmon
  - Windmill capacity: 850 kW
- Production costs from egg to 4-5 kg salmon (all inclusive): 4,9 USD per kg HOG
- Sludge used for biogas
Langsand Salmon - A RAS for a yearly production of 1.000 tons 4-5 kg salmon:

Status September 2013:

• Total numbers of batches: 8
• Already at first batch we experienced Furunculosis, today we vaccinate the fish
• Still challenges regarding early maturation, but we still improve a lot
• First hatch July 2011 – First harvest Q3 2013
• Production costs from egg to 4-5 kg salmon (all inclusive): 4,9 USD per kg HOG
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RAS Design Innovations and Opportunities for New Technologies

Focus area:

Energy consumption:

- Lifting height – Propeller pump
- Pressure loss
- Addition of pure oxygen
RAS Design Innovations and Opportunities for New Technologies

Focus area:

Sludge thickening: 30% DM by use of coagulant, polymer, belt-filter and centrifuge:
RAS Design Innovations and Opportunities for New Technologies

Focus area:

Sludge thickening: 92% DM by use of belt-filter, drumfilter and composting:
RAS Design Innovations and Opportunities for New Technologies

Focus area within REFA projects (Innovation consortium in Denmark):

- CO₂ equilibrium kinetics investigations
- CO₂ modeling and experiments with CO₂ –stripping efficiency
- Sludge mineralization
- Particle removal in recirculation plants. Impact of different mesh sizes on mechanical filters in respect to bacteria content in water, BOD load, performance of biological biofilters
- On-line measurement of bacteria content in process water in RAS
- Ultrafiltration and membrane bioreaktor (MBR)
- Nitrate removal – De-nitrification
- Energy efficient aeration with turbo compressors
- Development of sensor technology.
- Full-scale sanitation (UV) experiments with water quality analysis and bacterial online measurements
- Monitoring of fish movements (development of early warning sensor using the fish as a sensor)
- Design of new Moving Bed biofilter elements
- Design of new compact biofilter units for process water and effluent water treatment in aquaculture
Thanks for your attention