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

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



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



Aquatir – Moldova – www.aquatir.md





Beluga



Russian sturgeon











Bester

Aquatir Facility in Moldova - Lay-out



Sturgeon Facility: Live Feed-, Incubation-, Hatchery-, Startfeeding-, Juvenile-, and Broodstock Units



Sturgeon Facility: 2 On-Growing Units





Sturgeon Facility in Moldova, Sheriff – Broodstock Unit 1 of 3









Sturgeon Facility in Moldova, Sheriff – Broodstock Unit 1 of 3





Sturgeon Facility in Moldova, Sheriff – Broodstock Unit 1 of 3



Sturgeon Facility in Moldova – Some of the products



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Location: In a town called "Hvide Sande" in Denmark located in the center of Scandinavia



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

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.)

On the following dias, the "Langsand Salmon" project will be presented......

Owners:	Atlantic Sapphire, a former organic Salmon farming company	- 25%
	Steensgaard Holding, owner of Billund Aquaculture	- 20%
	Polar Salmon, a Salmon procesor	- 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



- 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.





Incubation

Hatchery

Smolt

Grow-Out

Harvest

Langsand Salmon - A RAS for a yearly production of 1.000 tons 4-5 kg salmon: 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

On-Growing system: Water flow through the system:







Langsand Salmon - A RAS for a yearly production of 1.000 tons 4-5 kg salmon: On-Growing system: Water flow through the system:







On-Growing system: Water flow through the system:







Production flow per batch (4 batches per year):



First hatch July 2011 – First harvest Q3 2013 (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



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

Bjarne Hald Olsen, CEO of Billund Aquaculture