

**BIO-BLOK® INTELLIGENT FIXED FILM BIOLOGICAL FILTER MEDIA****3.1.5. Case Studies****1. Mosbjerg fish farm**

Technical information	Submerged filter constructed in 1997
Type	BIO-BLOK® 200, 55x55x60 cm
Client	Mosbjerg Dambrug (fish farm), Denmark
Consulting Engineers	Kåre Michelsen Jens Baggesens Vej 20 DK-8660 Skanderborg Tel./fax: +45 86 52 50 52

Brief description of plant and process

Biological lamella separation is very suitable for removal of suspended solids that are not able to settle in normal sedimentation plants.

Above plant has been designed to treat a volume of water of 2 x 300 l/sec. from a trout farm.

The plant is constructed of 1 layer of BIO-BLOK® 200 size 55 x 55 x 60 cm. The maximum hydraulic surface load has been projected to be approx. 22 m/h corresponding to a consumption of filter medium of approx. 57m3.

The principle of biological lamella separation is that the biological surface will attract the sludge particles that are being transported through the filter by the water. Thus a natural filtration of the filter takes place, and at the same time, sludge will be formed on the filter (biofilm).

Besides an effective filtration of suspended solids from the water, these bacteria will immediately start a biological treatment of the water that passes through the filter.

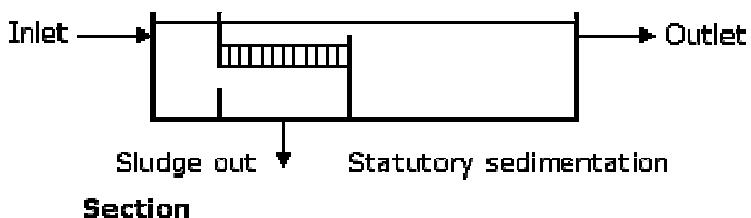
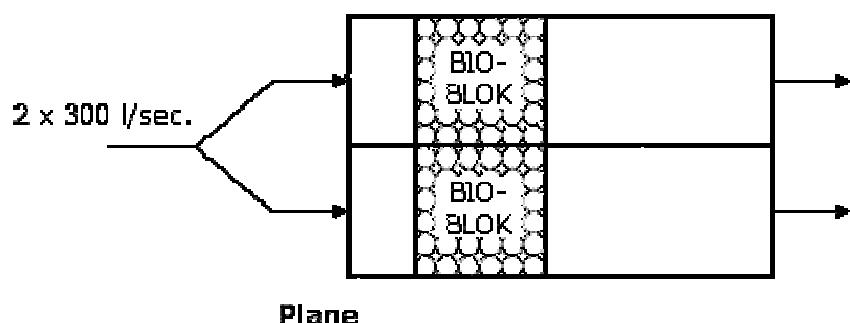
The sludge is drained off from the plant when necessary, however, minimum once a month. In connection with this draining, the filter medium is washed down to remove the remaining biofilm.

Biological lamella separation can be used in places where "sludge flight" can occur and where sludge particles use a lot of time to settle.

The hydraulic surface load and types of filter are decisive factors that determine the efficiency of a biological lamella separation.

The plant is new-installed, therefore, we have no analysis results yet.

The plant is expected to be able to reduce BOD5 by minimum 10% of the total admission in the fish farm and to reduce the suspended solids by 10% to 30% of the total supply of solids.



Principle drawing

See Load tests from Mosbjerg fish farm (18th to 24th of September 1998), Transport of matters:

Comments on the results from the load tests from Mosbjerg fish farm

It is noted that biological lamella separation works as intended as SS is reduced from 5.2 mg/l to 2.7 mg/l. We draw your attention to the fact that the inlet water contains 4.3 mg/l.

It is noted that aeration with BIO-BLOK® 80 HD G in the outlet water is extremely effective because the content of oxygen in the outlet water is higher than the content of oxygen in the inlet water (8.65 > 8.28).

It is noted that the fish farm keeps the BOD5 with regard to maximum increase through the fish farm of 1 mg BOD5/l.

It is noted that a denitrification takes place in the biological lamella sedimentation and sedimentation basin and that quite some phosphorous will settle biologically in the liberated biofilm.

The nitrification in the biological lamella sedimentation is small. This is due to the fact that the organic load on the filter is too big. (13.37 g/m² x day).

If this load is lowered, it is possible to get less pollution in the outlet than the fish farm receives in the inlet; i.e. the fish farm does not pollute its surroundings.

This can be made probable in the following:

		Existing treatment plant		
Organic load on BIO-BLOK [®]		13.37 g/m²	6.68 g/m ²	4.45 g/m ²
Hydraulic surface load		19.5 m/h	10 m/h	6.5 m/h
BOD ₅	Outlet	3.0 mg/l	2.56 mg/l	2.13 mg/l
Total N	Outlet	4.6 mg/l	less	much lesser
Ammonia	Outlet	0.43 mg/l	less	much lesser
Total P	Outlet	0.21 mg/l	0.2 mg/l	less
SS	Outlet	2.7 mg/l	2.0 mg/l	much lesser
Oxygen	Outlet	8.65 mg/l	8.65 mg/l	8.65 mg/l

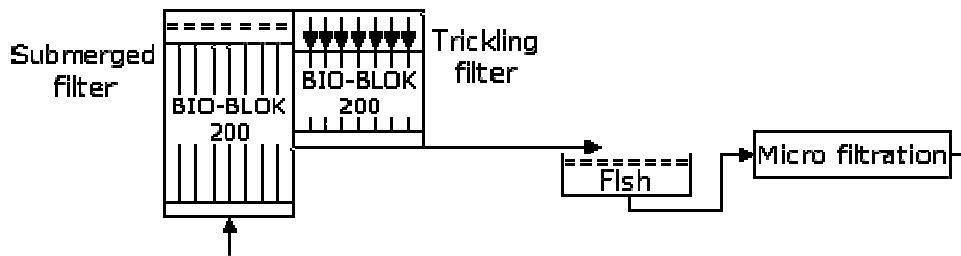
2. Sustainable Shrimp Aquaculture in Thailand

Recirculated sea-water systems

Technical information	Submerged filter and trickling filter constructed in 1992
Type	BIO-BLOK [®] 200
Client	DIFTA - Danish Institute for Fisheries Technology and Aquaculture
Consulting Engineers	DIFTA A/S Nordsøcentret, Box 59 DK-9850 Hirtshals Tel.: +45 98 94 43 00 / Fax: +45 98 94 22 26

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Process diagram

Brief description of plant and process

DIFTA - Danish Institute for Fisheries Technology and Aquaculture has on one of its recirculated sea-water systems at the Nordsøcentret (North Sea Centre) in Hirtshals used BIO-BLOK® 200 as biofilter material.

The biofilter system consists of 12m³ BIO-BLOK® 200 used as submerged filter and 5m³ BIO-BLOK® 200 used as trickling filter. The submerged filter is constructed as a downflow-upflow filter.

The plant has been operating since March 1992 with many different kinds of fish, with approx. 30 % salt-water and at a temperature of water of 22°C to 25°C.

Treatment results

In the first month as a newly established biofilter, an increasing content of ammonia (NH4+) was seen which after three weeks reached maximum values of 12 to 15 mg/l. During the next two weeks, the content was reduced to a level of 0.5 to 3 mg/l, and subsequently it has not exceeded this level.

Three weeks after the starting up, a nitrite (NO₂) increase was noted which reached values of 25 to 30 mg/l. This high level of nitrite kept steady for a relatively long time even though the feeding was very moderate. After ten weeks' operation, the level declined to 2 to 5 mg/l, and subsequently, it has not exceeded this level.

In September 1992, the system was operating with the following values:

Ammonia 0 to 1 mg/l and nitrite 0 mg/l by a feeding of 8 to 12 kg feed per day

In August 1993 the system was operating with the following values:

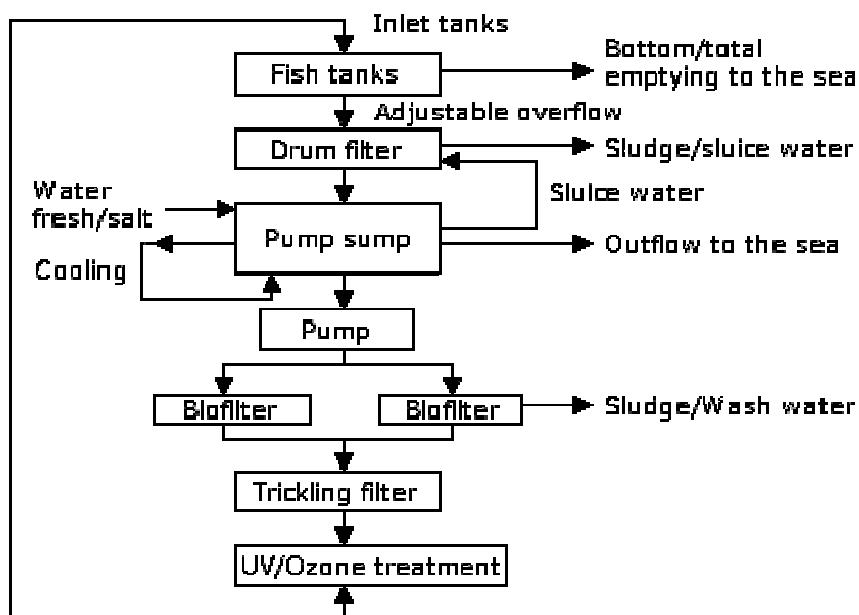
Ammonia 0 to 1 mg/ and nitrite 0 mg/l by a feeding of 15 to 16 kg feed per day

Therefore, the decomposition in the filter constructed with BIO-BLOK® 200 has worked extremely satisfactorily by the mentioned load.

3. Bornholm's salmon hatchery - Smolt production

Technical information	Submerged, aerated filter constructed in 1993-1994
Type	BIO-BLOK® 200
Client	Bornholms Amt (county), Denmark
Consulting Engineers	MATCON A/S Parallelvej 15 DK-2800 Lyngby Tel.: +45 44 91 32 64 / Fax: +45 45 97 21 14

Flow diagram for treatment of water Section I - II - III



Process diagram

Brief description of plant and process

The mechanical treated water is led from the fish tanks to the biological treatment plant. This treatment plant is constructed as a submerged filter which is constructed of 130m³ BIO-BLOK® 200 size 55x55x55cm. As the biological treatment unit is the heart of a recirculation plant, BIO-BLOK® 200 has been chosen as this filter medium ensures a stable operation and a high decomposition of ammonia.

The BIO-BLOK® 200 is constructed of net tubes which have been developed with a special surface structure resulting in a quicker development of the biological growth. This - together with the big biological accessible surface - results in the fact that the biological decomposition becomes optimum and without problems.

Key data of plant

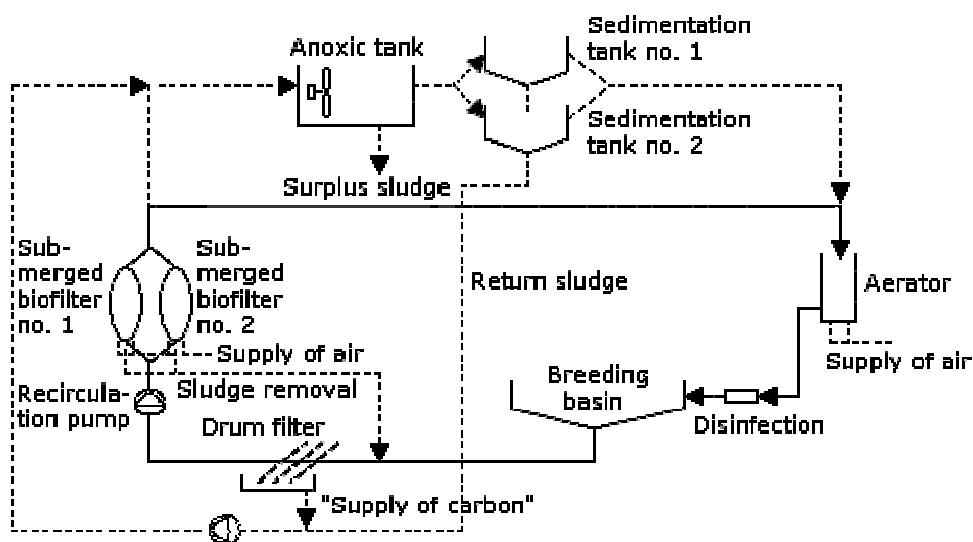
Production capacity:	Salmon smolt, 50g - 200,000 pcs.
Feed consumption:	8,000 kg/year
Buildings:	2 buildings, insulated, 34m x 16m. Total area: 1,088m ²
Tank capacitys:	
Hatching section:	88 trays
First feeding:	1m x 1m, 24 pcs. 24m ³
Section II:	2m x 2m, 10 pcs. 24m ³ diameter 3m, 12 pcs. 85m ³
Section III:	diameter 3m, 4 pcs. 28m ³ diameter 6m, 6 pcs. 254m ³
Total:	415m ³
Pump capacity:	700m ³ /h
Power consumption:	200,000 kWh/year
Water consumption at max. production:	30m ³ /day ~ 7%/day

Process

From the tanks the water passes a mechanical drum filter, where particles are removed. Ammonia is removed in the biofilters, after which the water is aerated in trickle filters. Before the water returns to the tanks it is treated in a UV/Ozone unit. Sludge from drum filter goes to a settlement tank. Clear water is led to the sea, and concentrated sludge is used as fertiliser on farm land. Electricity consumption has been minimised through the use of frequency control of the circulation pumps according to the water flow needed.

4. Non polluting fish farm - Test plant

Technical information	Submerged filter constructed in 1993-1994
Type	BIO-BLOK® 200
Client	Miljøstyrelsen (the Danish Environmental Protection Agency)
Consulting Engineers	MATCON A/S Parallelvej 15 DK-2800 Lyngby Tel.: +45 44 91 32 64 / Fax: +45 45 97 21 14



Process diagram

As the biological treatment unit is the heart of a recirculation plant, BIO-BLOK® 200 was chosen as this filter medium ensures a stable operation and a high decomposition of ammonia. The treatment plant is constructed as a submerged filter which is made of BIO-BLOK® 200, size 55x55x55cm.

The BIO-BLOK® 200 is constructed of net tubes which have been developed with a special surface structure resulting in a quicker development of the biological growth. This - together with the big

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biological accessible surface - results in the fact that the biological decomposition becomes optimum and without problems.

Key data of plant

Tank capacity:	1 pcs. Hatching trough with 4 trays. 2 pcs. 1m x 1m, 1,0m ³ 2 pcs. 2m x 2m, 4,8m ³ Total: 5,8m ³
Pump capacity:	20m ³ /h
Water consumption:	
Renewal:	1 - 2 l/kg feed
Evaporation:	2 - 3 ⁰ /oo day
Feed consumption:	2.7 kg/day
Feed conversion:	0.8
Production:	150 kg/m ³ /year
Sludge:	0.3 kg/kg feed

From the fish tanks the water goes to the mechanical filtration in a drum filter. Ammonia is converted to nitrate in the biofilters. Leaving the biofilters the water is aerated in a trickle filter, and then treated in a UV/Ozone unit before being returned to the fish tanks. Part of the circulated water is treated in a denitrifying unit, where nitrate is converted to free nitrogen.

Results

A comprehensive measuring programme has been conducted in order to document the processes. During the trials in the pilot plant, a process has been developed, making it possible to use the same water for long periods. In the plant the same water has been used for half a year without renewal. The amount of sludge being produced has been reduced significantly compared to other recirculated fish farms. The mortality of the fish has been very low, and no fish diseases have been found.

The process is patented.

The test results can be seen in a report (No. 40 - 1994 concerning a test with 100% recirculation in fish farming) from the Danish Environmental Protection Agency, Ministry of Environment. The report can be order from:

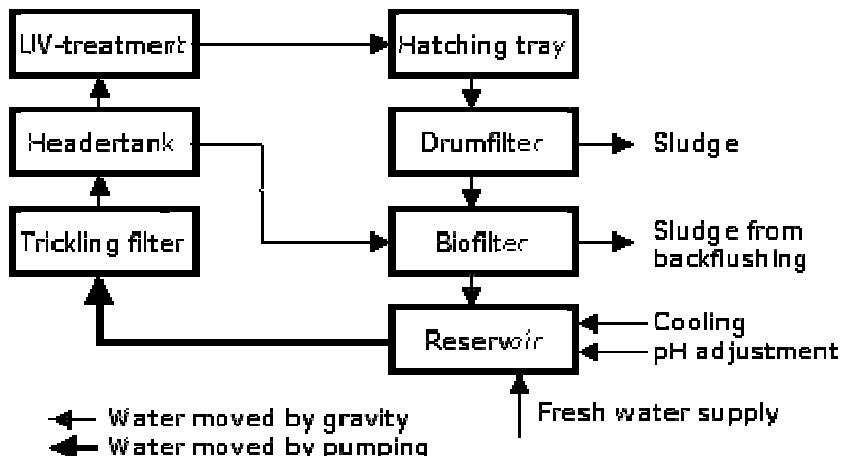
Miljøministeriet, Miljøstyrelsen
Strandgade 29, DK-1401 København K.

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5. Salmon and Sea Trout Hatchery

Technical information	Submerged filter and trickling filter constructed in 1998.
Type	BIO-BLOK® 200
Client	AssiDomän - Mörrums Kronolaxfiske- Sweden
Consulting Engineers	<p>RAMBØLL</p> <p><i>DANAQ CONSULT worked as a subcontractor for RAMBØLL</i></p> <p>DANAQ CONSULT Asnaesvej 40, DK-4400 Kalundborg - Denmark Tel.: +45 59 56 00 50 / Fax: +45 59 56 00 48</p>



Process diagram

Brief description of process

The water leaves the trays and runs by gravity through a mechanical filter where particles are removed. The particles leave the system and the mechanical cleaned water is by gravity led to a submerged biological filter where organic matter is decomposed and the toxic ammonia transformed to the non-toxic nitrate. From the biofilter the water runs to a reservoir and is pumped up and spread over a trickling filter where carbondioxide is removed and replaced by oxygen. From the trickling filter the water falls down into a headtank from where most of the water runs by gravity through a UV-unit and back to the hatching trays and a minor part runs back through the biofilter.

Key data of the hatchery

Hatching capacity	1.9 mill. eggs of Salmon and Sea Trout		
Production capacity	600,000 pcs. of 0.5 gram Salmon fry		
Biofilter capacity	30 kg feed/day		
Submerged filter	15m ³ BIO-BLOK® 200		
Trickling filter	3.8m ³ BIO-BLOK® 200		
Pump capacity	50m ³ water/hour		
Power consumption	Cooling unit Recirculation pump Drumfilter UV-filter	12.50 kW 1.10 kW 0.93 kW 0.66 kW	
Water consumption	1% of the total water volume per day		

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