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Responsibility
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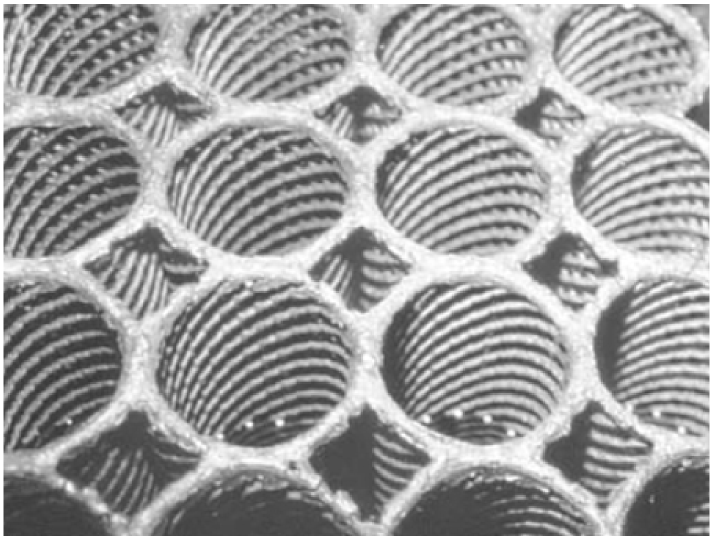
Biological lamella sedimentation

Responsible Seafood Advocate logo

1 December 2001 Odd-Ivar Lekang Anne Marie Bomo Ingfrid Svendsen

New system uses polyethylene pipes to remove small particles



The biofilm established in the Bioblocks improves sedimentation by attracting small particles.

Sedimentation is a useful technique to manage aquaculture wastewater, because a high proportion of the suspended solids have a high sinking rate. Sedimentation is a relatively low-cost system for particle separation and the process normally involves no moving parts. But sedimentation efficiency decreases with decreasing particle size, and traditional sedimentation basins require large areas at relatively high capital costs.

To increase the efficiency and area for sedimentation, swirl separators or tube/plate settlers may be used. Other new, low-cost systems for wastewater treatment are also evolving.

New method

A new sedimentation method, called biological lamella sedimentation, involves a combination of traditional sedimentation and tube settlers. In this system, water is forced to pass through “Bioblocks” installed in the sedimentation basin below the surface. Bioblocks are pipes of 70-mm inner diameter spun polyethylene with an open-pore structure and a large surface, nested together to form blocks.

Primarily designed for use in nitrification filters, the blocks improve the removal of small particles. A biofilm is established in the blocks, and small particles attach to it.

Testing BLS

In a 1999 experiment, a biological lamella sedimentation basin was installed on the outlet of a 0.5-cubic-meter fish tank that contained 123 rainbow trout with an average weight 206 grams. Water and sludge samples were taken for evaluation.

The amount of total suspended solids through the sedimentation basin decreased by an average of 32.5 percent (Table 1). There were minor differences in total phosphorus and total nitrogen levels between inlet and outlet water. However, there were large individual differences in the measured values for several water parameters, even when using an automatic water sampler that takes samples day and night. This shows it is difficult to take representative water samples from the outlet of a single fish tank.

Table 1. Concentrations and removal rates for water parameters measured in the sedimentation basin.

Sampling Date	Total Suspended Solids (mg/l)			Chemical Oxygen Demand (mg/l)			Total Phosphorus (µg/l)			Total Nitrogen (mg/l)		
	In	Out	Re. %	In	Out	Re. %	In	Out	Re. %	In	Out	Re. %
09/03/99	6.49+1.13	4.12+1.39	35.2	11.3+2.5	8.3+0.8	26.5	88+19	86+29	2,2	2.08+0.16	2.05+0.08	1.44
11/03/99	6.12+1.01	4.75+1.95	22.4	8.2+2.5	9.5+1.6	<0	48+23	58+14	<0	1.87+0.05	1.92+0.04	<0
15/03/99	8.25+3.63	4.95+2.88	40.0	9.2+3.0	5.8+0.8	37.3	71+28	77+19	<0	2.03+0.08	2.05+0.08	<0

On the basis of total assigned feed, fish growth, and collected sludge, the average removal rates for total phosphorus and total nitrogen were 44.1 percent and 3.32 percent, respectively (Table 2). The actual removal rates were, in fact, somewhat higher, because the material settled on the blocks should have been included. The average total dry matter, total phosphorus, and total nitrogen values were 2.15, 5.17 and 2.14, respectively. A total of 98.3 grams of dry matter per kilogram fish produced was collected.

Conclusion

Table 2. Mass budget- based estimates of effluent treatment efficiency and post-treatment discharge. Budget does not include settled material on bioblocks.

Criterion	Total Phosphorus	Total Nitrogen
Supplied in feed (g)	65	374
Retained in fish stock (g)	18.1	115.8
Collected sludge (g)	20.7	8.56
Effluent load:		
g	26.2	249.6
% of supplied	40.3	66.74
g kg feed^{-1}	5.03	49.7
g kg fish gain^{-1}	6.5	62.08
Total removal rate (%)	44.1	3.32

Even though this sedimentation basin showed reasonable removal rates, there are several ways the removal rate could be improved. Since most of the particles settled close to the inlet, placing a separate sludge collector there may improve the efficiency, and visual checks of feed loss would be easier. The block closest to the outlet might also be lowered below the water surface to ensure good distribution through all the "pipes."

With the current design, the water must pass through the grating in the blocks, and even if some filtration results, the capacity is reduced. Bioblock clogging may be a problem, though this did not occur either in this or other preliminary experiments. Regular use of air bubbles from diffusers placed beneath the blocks, or manual or automatic block vibration are possible solutions. The water velocity must be low when doing this to ensure that dislodged material sinks and does not follow the water flow out of the basin.

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