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# Nitrification efficiency of biofilters containing different filter media in simulated seawater aquaculture system

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## Introduction

Ammonia in aquaculture system may lead to suppression of fish growth, sublethal histopathological changes, and even death thus ammonia is considered toxic to fish. Tricking filter and submerged filter have many advantages include: low construction cost, easy management and maintenance, and well adaptation to different water and waste loading rates. For optimal nitrification and less clogging of the biofilter, the biofilter media should have high surface area and low specific gravity (Lekang and Kleppe, 2000). The nitrification efficiencies of coarse sands, styrofoam beads, and loess bead were tested in a simulated aquarium system. The obtained data would be useful for selection of the suitable biofilter medias for live fish aquarium systems.

## Materials and methods

The system consists of culture tank, recirculating pump, three biofilters, feed tank, metering pump, and thermostatic heater system. The biofilter column was made of PVC pipesr (1 m high and 30 cm in diameter). Approximately 20 liter of biofilter media was used in each biofilter. Ammonia loading rates are around 100 g $N/m^2/day$ and HRT was set at 200 $m^3/m^2/day$. Styrofoam bead has an average diameter of 1.4 mm and SSA is 2820 $m^2/m^3$. Loess bead have the lowest SSA of 225 $m^2/m^3$ and sand has SSA of about 950 $m^2/m^3$.

## Results and Discussion

The TAN conversion rate averaged 682, 269, 79 g TAN-N $/m^3/day$ for styrofoam bead, sand and loess bead filters, respectively. Nitrite

accumulations were found in the outlet waters for all three biofilters. The nitrite nitrogen removal rates averaged 384, 154, and 41 g /$m^3$/day for styrofoam bead, sand and loess bead, respectively. Based on the TAN and nitrite conversion rates, styrofoam bead showed the best performance among the three filter medias tested. Also, the low gravity and price of styrofoam bead make handling more easier and commercial application more cost-effective. However, the accumulation of nitrite may be a problem for practical application. Decrease the water loading rate or increase the media depth may be helpful. Nevertheless, the use of synthetic wastewater in present experiment should be questioned. Flooded conditions found in sand filter column already indicated the tendency towards clogging.

Table 1. Average nitrification, nitrite production, Total alkalinity and oxygen consumption of three biofilter medias tested in present experiment.

| Item | Styrofoam bead | Sand | Loess bead |
|---|---|---|---|
| Total nitrification (mg/l) | $0.95 \pm 0.05^a$ | $0.37 \pm 0.03^b$ | $0.11 \pm 0.01^c$ |
| VTR (g TAN-N/$m^3$/day) | $682 \pm 35^a$ | $269 \pm 8^b$ | $79 \pm 5^c$ |
| ATR (g TAN-N/$m^2$/day) | $0.24 \pm 0.01^b$ | $0.27 \pm 0.01^{ab}$ | $0.31 \pm 0.02^a$ |
| Nitrite production (mg/l) | $0.44 \pm 0.02^a$ | $0.20 \pm 0.01^b$ | $0.06 \pm 0.01^c$ |
| ANR (g $NO_2$-N/$m^2$/day) | $0.13 \pm 0.01$ | $0.16 \pm 0.01$ | $0.15 \pm 0.01$ |
| VNR (g $NO_2$-N/$m^3$/day) | $384 \pm 32^a$ | $154 \pm 13^b$ | $41 \pm 4^c$ |
| VAR (g $CaCO_3$/$m^3$/day) | $4343 \pm 361^a$ | $1772 \pm 48^b$ | $534 \pm 45^c$ |
| Oxygen consumption (mg/l) | $4.1 \pm 0.2^a$ | $1.5 \pm 0.2^b$ | $0.4 \pm 0.1^c$ |
| OCR (g $O_2$/$m^3$/day) | $2978 \pm 128^a$ | $908 \pm 32^b$ | $280 \pm 7^c$ |

Values within the same row with different letters are significantly different ($P<0.05$).

## References

Lekang Odd-Ivar and Kleppe H., 2000. Efficiency of nitrification in trickling filters using different filter media. Aquaclt. Eng. 21, 191~199.