Ammonia Removal Characteristics by Biofilter Using Inorganic Carriers Seeded with Nitrifying Bacteria Enriched from Night Soil Sludge

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...duction Ammonia removal by biofilters was conducted mainly using organic packing-materials as a carrier like peat (1,2) or wood bark (3), but inorganic packing materials (4,5) were rarely used. In this study, as inorganic packing materials, porous ceramic (A) and foamed inorganic material covered with glass layer (C) which was porous and light, were used. To shorten the acclimation period, nitrifying bacteria enriched from night soil sludge were applied to biofilters. The ammonia removal characteristics by A and C biofilters were investigated.

Materials and methods Nitrifying bacteria enriched in P-medium (6) for 10 days were harvested by centrifugation, washed, and then resuspended in P-medium. This suspension was applied to biofilters with A and C as a packing material. The initial cell number of nitrifying bacteria was at an average of 10^8 cells/kg-dry material. Characteristics of packing materials were previously reported (5). Condition of temperature, pH of packed bed, analysis of ammonia in air and analysis of nitrite and nitrate are the same as previously reported (2). The drain water was resprayed to the packed bed everyday. When the nitrite concentration reached about 8000 ppm, the drain water was disposed and the packed beds were sprayed with fresh P-medium without ammonium sulfate. The operational conditions and removal characteristics of biofilters are shown in Table 1.

Table 1. Operational conditions and comparison of ammonia removal characteristics of A and C biofilters seeded with nitrifying bacteria enriched from night soil sludge.

Packing material	Porous ceramic (A)	Foamed material (C)
Packing density (kg-dry material/L)	0.24	0.13
Ammonia gas flow		
Inlet concentration (ppm)	60 - 200	60 - 170
Flow rate (L/min)	0.4 - 1.6	0.4 - 1.4
Load (g-N/kg dry material/d)	0.26 - 2.87	0.24 - 2.29
Ammonia removal characteristics		
Complete removal (g-N/kg dry material/d)	2.1	1.5
Maximum removal capacity (g-N/kg dry material/d)	2.9	2.1
Average removal ratio (%)	95	88

Results and discussion We have shown high complete removal of ammonia by A and C biofilters seeded with sludge at 1.5 g-N/kg-dry material/d which reached in 60d (4). In this study, enriched nitrifying bacteria and high ammonia concentration were initially introduced to biofilters. Figures 1 and 3 show the result. About 80 ppm ammonia was introduced to the biofilters at load of 0.25 g-N/kg-dry materials/d for the first 2 weeks and then the load was increased gradually up to 2.87 g-N/kg dry A/d and 2.29 g-N/kg dry C/d (Figs. 1c and 3c), respectively. The acclimation period of both biofilters was observed at about 9d (Figs. 1a and 3a), which was faster than about 20d of acclimation period of peat (2) or activated carbon fiber (ACF) biofilters seeded with night soil sludge (2,4).

From the relationship between load and removal capacity (Figs. 2 and 4), complete removal of A and C was observed at 2.1 g-N/kg-dry A/d and 1.5 g-N/kg-dry C/d, respectively, which reached in 17d (Figs. 1c and 3c). In A and C biofilters seeded with sludge (4), complete removal at 1.5 g-N/kg dry material/d reached in 60d. The physical characteristics of A and C are almost similar (4), but the ammonia removal characteristic of material A is better than that of C (Table 1), indicating that affinity of enriched nitrifying bacteria on the porous of packing material A is higher than C.

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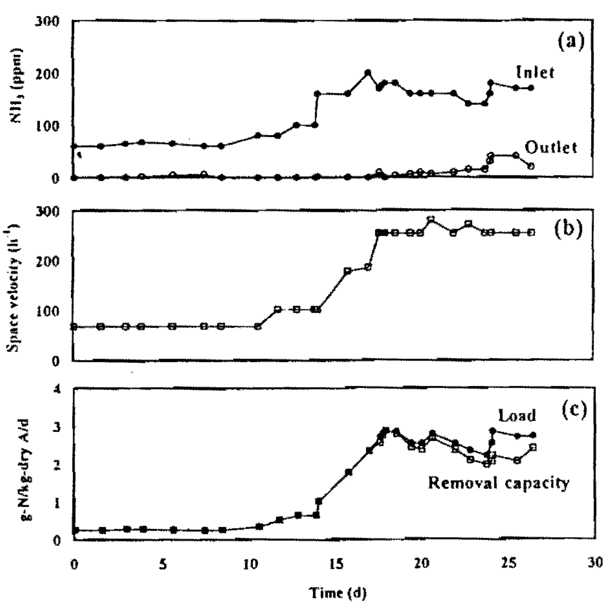

Fig. 1. Ammonia removal by A biofilter seeded with nitrifying bacteria enriched from night soil sludge : (a) inlet and outlet ammonia concentration, (b) space velocity, and (c) load and removal capacity.

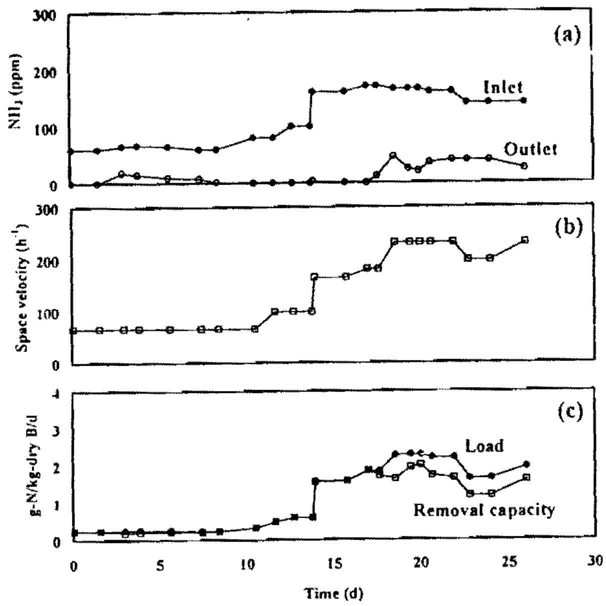

Fig. 3. Ammonia removal by C biofilter seeded with nitrifying bacteria enriched from night soil sludge : (a) inlet and outlet ammonia concentration, (b) space velocity, and (c) load and removal capacity.

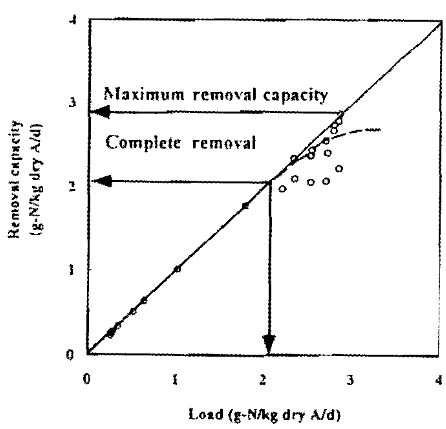

Fig. 2. Relationship between load and removal capacity of ammonia in A biofilter seeded with nitrifying bacteria enriched from night soil sludge.

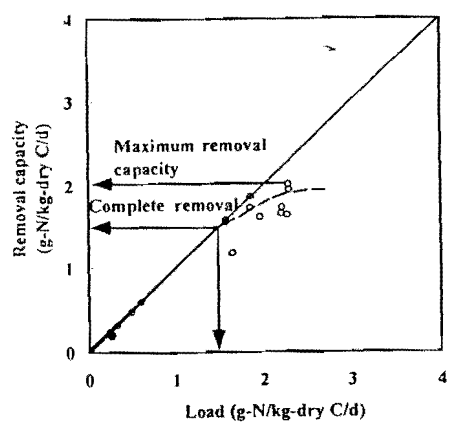

Fig. 4. Relationship between load and removal capacity of ammonia in C biofilter seeded with nitrifying bacteria enriched from night soil sludge.

Key word : ammonia removal, nitrifying bacteria, biofilter, inorganic carrier