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PACKED-BED BIOLOGICAL DENITRIFICATION FILTER WITH ANTHRACITE MEDIA

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INTRODUCTION

Packed-bed biological denitrification filter is one of the processes for nitrate removal. Methanol is the most commonly used a hydrogen donor in this process. The aim of this paper is to present the denitrification rate and performance of packed-bed biological denitrification filter with anthracite media using methanol as a hydrogen donor.

MATERIALS AND METHODS

The experiment was conducted in packed bed granular filters using anthracite media to support the growth of denitrifying bacteria. The media was packed to a depth of 800±50 mm from the bottom of filters. The characteristics of raw water fed into filters are depicted in Table 1. Two different media sizes of 4.00-4.76 mm and 2.00-2.83 mm were tested. Filtration rate of 100 m/d was operated in upflow mode under a controlled temperature of 20±1 °C. The filters were operated in such a way that backwashing was done everyday. Samples were taken from every sampling ports along filter length at about 20 hours after backwash.

TABLE 1. The Characteristics of Raw Water Fed into Filters.

Parameters	Filter A (with media size of 4.00-4.76 mm)	Filter B (with media size of 2.00-2.83 mm)
NO ₃ ⁻ -N (mg/l)	4-11	4-11
NO ₂ ⁻ -N (mg/l)	<0.4	<0.4
NH ₄ ⁺ -N (mg/l)	0	0
PO ₄ ³⁻ (mg/l as PO ₄ ⁻³)	6	6
DO (mg/l)	8.5	8.5
pH	7.8	7.8
ALK. (mg/l as CaCO ₃)	150	150
CH ₃ OH (mg/l as TOC)	Excess	Excess

RESULTS AND DISCUSSIONS

Denitrification Rate

Based on the experimental results, graphs relating to denitrification rate (dN/dZ) and nitrogen concentration (N) were drawn as shown in Figure 1. This was done so as to examine rate of denitrification reaction. The results could be

interpreted to establish a denitrification rate by using the Monod's equation, $dN/dZ = -\gamma \cdot N / (k_s + N)$. The values of $\gamma = 26 \text{ g/m}^4$, $k_s = 3.7 \text{ g/m}^3$ for the filter A and $\gamma = 41 \text{ g/m}^4$, $k_s = 2.9 \text{ g/m}^3$ for the filter B.

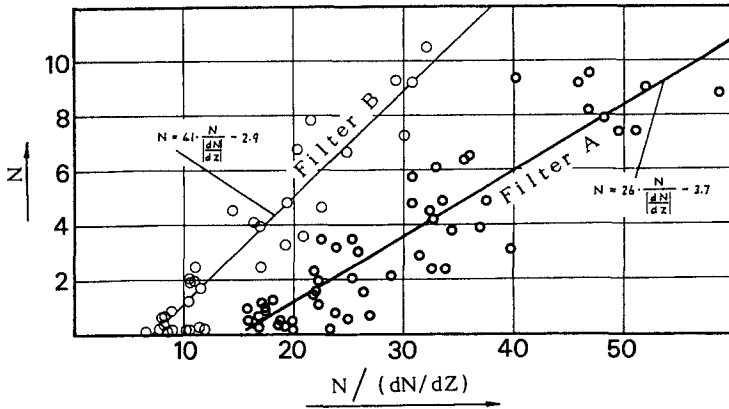


Figure 1. Denitrification rate constant determination.

Denitrified Water Quality and Nitrogen Removal Efficiency

As can be seen in Figure 2, it was found that nitrogen concentration could be reduced from about 10 mg/l to lower than approximately 0.5 mg/l with the filter A and to approximately 0 mg/l with the filter B. In addition, nitrogen removal efficiency of the process achieved a steady state just after backwashing and kept so for more than one day.

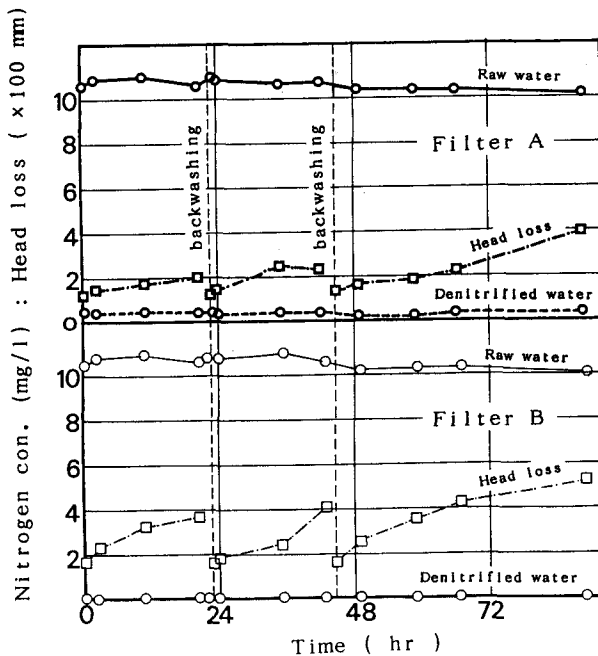


Figure 2. Water quality and head loss.