In-situ Denitrification Process with Injection of Electrolytic Hydrogen and Oxygen

Waseda University Student Member ○Jian Ye
Waseda University Sayo Morimoto
Waseda University Syotaro Ino
Yamato Inc. Masahito Komori
Waseda University Regular Member Yutaka Sakakibara

1. INTRODUCTION

Nitrate contamination in groundwater has been detected in many parts around the world. In order to reduce the nitrate in protecting the drinking water source, an *in-situ* denitrification process using electrolytic hydrogen and oxygen was proposed and the possibility of denitrification and oxygenation were studied experimentally.

2. MATERIAL AND METHODS

Fig. 1 shows an apparatus used in the study. Main part is an artificial aquifer which size is 2050 mm in length, 75 mm in width and 860 mm in height. The aquifer is filled with glass beads (φ=2 mm). There are 18 ports on one side and they are divided to columns from 1 to 6. The composition of feed solution is shown in table 1. In experiment, an enriched culture was injected to the ports 1 to 9 while suspension from soil/water mixture to the ports 10 to 18. After seeding, hydrogen gas and oxygen gas were injected at the bottom of port 6 and port 15, respectively. Operation parameters are shown in table 2.

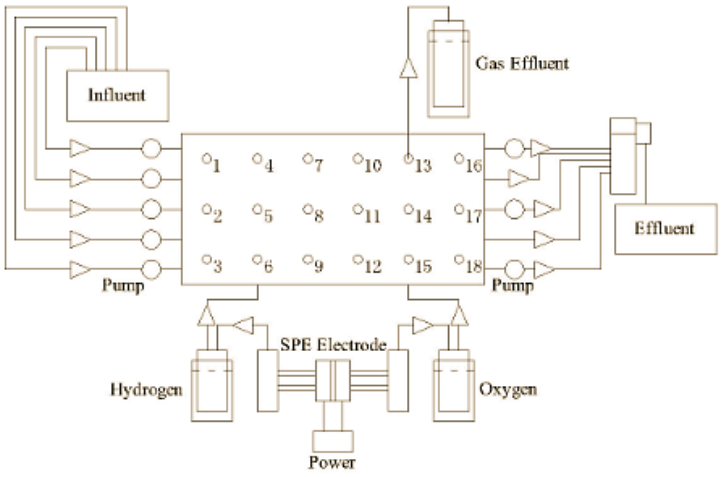

Fig. 1: Experimental Apparatus

Table 1: Composition of Feed Solution

Chemical	Concentration	Chemical	Concentration	Chemical	Concentration	Chemical	Concentration
K_2PO_4	1.76 (*mg/L*)	$MgSO_4{\cdot}7H_2O$	4.00 (*mg/L*)	NaCl	0.96 (*mg/L*)	$NaNO_3$	91.07 (*mg/L*)
$FeCl_3{\cdot}6H_2O$	1.92 (*mg/L*)	KH_2PO_4	2.08 (*mg/L*)	$CaCl_2$	1.12 (*mg/L*)	$NaHCO_3$	71.43 (*mg/L*)

Table 2: Operation parameters

Name	Mark	Unit	Value	Name	Mark	Unit	Value
Flow Rate	Q_w	*l/d*	6.0	Velocity	*U*	*m/d*	0.3
Effective Volume	V_w	*l*	16.0	Length of Apparatus	*L*	*m*	0.2
HRT	*t*	*d*	2.67				

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Contact address: Department of Civil and Environmental Engineering, Waseda University, 3-4-1 Okubo, Shinjuku Ku, Tokyo, 1698555
Tel/Fax: +81-3-5286-3902. E-mail: yejian_waseda@ruri.waseda.jp

3. RESULTS AND DISCUSSIOM

Fig. 2a and fig. 2d show the concentration change of nitrate, nitrite, pH and DO, respectively. As shown in the figures, nitrate concentration decreased with time, while nitrite increased. On the other hand, pH increased from 7.7 to 9.5. DO decreased around 1.6 *mg*/*L* in hydrogen injection zone and increased up to 25 *mg*/*L*.

Fig. 3 shows the profile of nitrate and nitrite on average. It can be seen that the nitrate nitrogen decreased from 15.2 *mg*/*L* to 0.6 *mg*/*L* on average in hydrogen injection zone and reached its minimum value. Then it increased up to 1.8 *mg*/*L* in oxygen injection zone. At the same time, the nitrite increased from 0 to 9.3 *mg*/*L* on average in hydrogen injection zone and decreased to 6.3 *mg*/*L* in oxygen injection zone.

From these results, it was considered the process of *in-situ* denitrification might be possible, but a further long-term study would be needed to evaluate the performance.

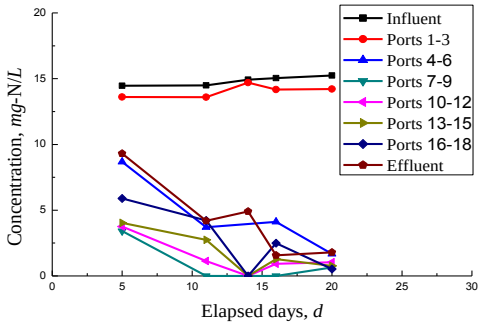

Fig. 2a Change of Nitrate Concentration

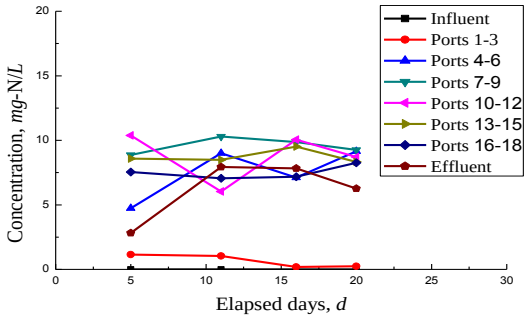

Fig. 2b Change of Nitrite Concentration

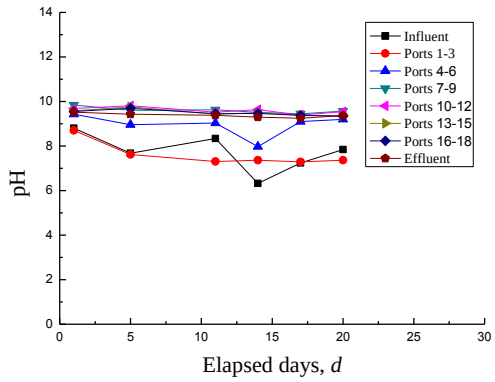

Fig. 2c Change of pH

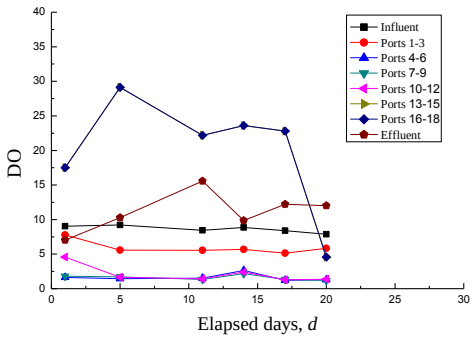

Fig. 2d Change of DO

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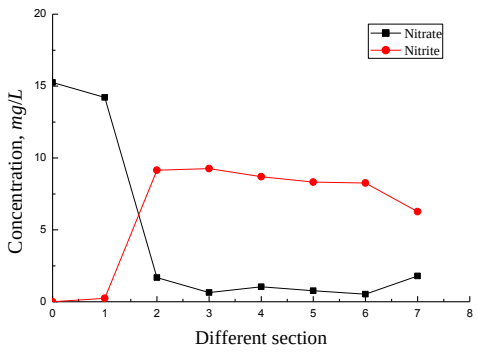

Fig. 3 Profile of day 20