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Nitrogen removal performance and functional genes distribution patterns in solid-phase denitrification sub-surface constructed wetland with micro aeration

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1 **Nitrogen removal performance and functional genes distribution patterns in**  
2 **solid-phase denitrification sub-surface constructed wetland with micro aeration**

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8 **Abstract**

9 An up-flow vertical flow constructed wetland (AC-VFCW) filled with ceramsite  
10 and 5% external carbon source poly(3-hydroxybutyrate-hydroxyvalerate) (PHBV) as  
11 substrate was set for nitrogen removal with micro aeration. Simultaneous nitrification  
12 and denitrification process was observed with 90.4%  $\text{NH}_4^+$ -N and 92.1% TN removal  
13 efficiencies. Nitrification and denitrification genes were both preferentially enriched  
14 on the surface of PHBV. Nitrogen transformation along the flow direction showed that  
15  $\text{NH}_4^+$ -N was oxidized to  $\text{NO}_3^-$ -N at the lowermost 10cm of the substrate and  $\text{NO}_3^-$ -N  
16 gradually degraded over the depth. *AmoA* gene was more enriched at -10 and -50cm  
17 layers. *NirS* gene was the dominant functional gene at the bottom layer with the  
18 abundance of  $2.05 \times 10^7$  copies  $\text{g}^{-1}$  substrate while *nosZ* gene was predominantly  
19 abundant with  $7.51 \times 10^6$  and  $2.64 \times 10^6$  copies  $\text{g}^{-1}$  substrate at the middle and top layer,  
20 respectively, indicating that functional division of dominant nitrogen functional genes  
21 forms along the flow direction in AC-VFCW.

22 **Keywords:** Vertical flow constructed wetland; Solid-phase denitrification; Aeration;  
23 Functional genes; Nitrogen removal

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