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Remediation of nitrate-contaminated groundwater in a denitrifying bioelectrochemical system

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ABSTRACT

Groundwater has become, in large parts of the world, the most important source of drinking water and its quality must be maintained. Nevertheless, groundwater pollution by anthropogenic nitrate is still being widely spread This study investigated the performance of a bioelectrochemical system in a laboratory scale to remove nitrate from groundwater in three different operational conditions: (i) open circuit, (ii) microbial fuel cell without externally applied potential, and (iii) microbial electrolysis cell with externally applied potential (0.3, 0.5, and 1.0 V). Initial nitrate concentration in the groundwater was 26.3 mg $N–NO_3^-$. The denitrifying bioelectrochemical systems (D-BES) reduced nitrate concentration to at least 8.3 mg $N–NO_3^-$, regardless of the operational condition, meeting the standards by the World Health Organization for water quality. The final nitrate concentration was even lower when D-BES was operated in microbial electrolysis cell (MEC) modes. MEC with 0.5 V reached nitrate concentration of 1.0 mg $N–NO_3^-$, being the best removal efficiency (96.2%). Additionally, there was no accumulation of nitrite and ammonium in the MEC modes, suggesting that energy currents might have stimulated the microbial community present in the D-BES. These results indicate that D-BES, especially under MEC operations, has the potential for nitrate bioremediation, with minimal maintenance and health risk.

Keywords: Bioelectrochemistry; Bioremediation; Contaminated groundwater; Nitrate removal; Wastewater

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