

Abstract

Nuclear wastes emerging from nuclear fuel cycle plants are generally rich in nitrates and heavy metals like Uranium. Nitrate and uranium have been identified as the major groundwater contaminants. Microbial fuel cells (MFCs) have the potential for denitrification and power production. However, the reported rates of denitrification in MFCs are low and there are no reports of U (VI) removal and/or simultaneous nitrate and U (VI) removal in a MFC. In this work, denitrification rate in a MFC is improved first by identifying an effective microbial consortium. High-rate denitrifying MFCs were developed using cow manure and soil. Further, the consortium was acclimatized under autotrophic (AD) and heterotrophic (HD) conditions to compare the power output and nitrate removal rate. The microbial communities were identified and found to exhibit resilience and high diversity. AD supported high power and HD supported high nitrate removal rate. Also, the abundance of denitrifying genes was assessed and they were present in both the conditions. The U (VI) was removed as a phosphate precipitate. Microbes at cathode produced phosphatase which liberated phosphate from an organic compound. Nitrate acted as an electron acceptor thereby allowing simultaneous nitrate and U (VI) removal. The work is extended to real low level effluents from nuclear fuel recycle division at BARC (Bhabha Atomic Research Centre), Mumbai. The MFC removed nitrate from these wastes while supporting power generation. In summary, this thesis work demonstrates the application of MFC for the removal of nitrate and U (VI) from contaminated water.

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