World Academy of Science, Engineering and Technology
International Journal of Environmental and Ecological Engineering
Vol:17, No:07, 2023

Sulfate Reducing Bacteria Based Bio-Electrochemical System: Towards Sustainable Landfill Leachate and Solid Waste Treatment

Authors : K. Sushma Varma, Rajesh Singh

Abstract : Non-engineered landfills cause serious environmental damage due to toxic emissions and mobilization of persistent pollutants, organic and inorganic contaminants, as well as soluble metal ions. The available treatment technologies for landfill leachate and solid waste are not effective from an economic, environmental, and social standpoint. The present study assesses the potential of the bioelectrochemical system (BES) integrated with sulfate-reducing bacteria (SRB) in the sustainable treatment and decontamination of landfill wastes. For this purpose, solid waste and landfill leachate collected from different landfill sites were evaluated for long-term treatment using the integrated SRB-BES anaerobic designed bioreactors after pre-treatment. Based on periodic gas composition analysis, physicochemical characterization of the leachate and solid waste, and metal concentration determination, the present system demonstrated significant improvement in volumetric hydrogen production by suppressing methanogenesis. High reduction percentages of Be, Cr, Pb, Cd, Sb, Ni, Cr, COD, and sTOC removal were observed. This mineralization can be attributed to the synergistic effect of ammonia-assisted pre-treatment complexation and microbial sulphide formation. Despite being amended with 0.1N ammonia, the treated leachate level of NO^{3-} was found to be reduced along with SO_4^{2-}. This integrated SRB-BES system can be recommended as an eco-friendly solution for landfill reclamation. The BES-treated solid waste was evidently more stabilized, as shown by a five-fold increase in surface area, and potentially useful for leachate immobilization and bio-fortification of agricultural fields. The vector arrangement and magnitude showed similar treatment with differences in magnitudes for both leachate and solid waste. These findings support the efficacy of SRB-BES in the treatment of landfill leachate and solid waste sustainably, inching a step closer to our sustainable development goals. It utilizes low-cost treatment, and anaerobic SRB adapted to landfill sites. This technology may prove to be a sustainable treatment strategy upon scaling up as its outcomes are two-pronged: landfill waste treatment and energy recovery.

Keywords : bio-electrochemical system, leachate /solid waste treatment, landfill leachate, sulfate-reducing bacteria
Conference Title : ICEBESE 2023 : International Conference on Environmental, Biological, Ecological Sciences and Engineering
Conference Location : Paris, France
Conference Dates : July 10-11, 2023