Microbial Fuel Cell: A Novel Device for Wastewater Purification and Heavy Metal Recycle

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Microbial fuel cell (MFC) is recently considered as a promising technique for the remediation of contaminated water. In this study, we constructed a novel MFC device to realize efficient removal and recycle of heavy metal ions from water. At first, we used artificial wastewater as the anolyte and Cu2+/Pb2+ solutions as the catholyte, inoculated 5% activated sludge into the anode. Running this MFC for 1 hour, more than 98% Cu2+ and Pb2+ were reduced to zero valent metals, precipitated on the electrode and the bottom of the cell observed by SEM. However, this device cannot reduce and precipitate Cd2+ and Cr6+ because their reduction potentials are low. Whereafter, we added a second anode compartment and made the device into a dual-anode MFC to lower the reduction potential. After running this dual-anode MFC for 5 hours, 98% Cd2+ and 90% Cr6+ were reduced to zero-valent metals and precipitated. For replacing solutions easily, we made three openings for the cathode and anode compartments to obtain a continuous flow MFC device. After running this continuous flow dual-anode MFC for 10 hours, the effluent Cu2+, Pb2+, Cr6+ and Cd2+ concentrations were 0.58 mg/L, 0.45 mg/L, 0.43 mg/L and 5.12 mg/L, respectively, with removal rates of 98%, 99%, 99% and 89%. The results demonstrated that our continuous flow dual-anode MFC effectively removes heavy metal ions and directly reduces them to zero-valent metals precipitated from water, which is of great significance for removal and recycle of heavy metals. Compared with existing electrokinetic remediation technologies, this MFC device itself generates an electrical current and do not need external voltage. In addition to removal of heavy metals, this device also reduces water COD.