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e-Book of Abstracts

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MICROBIAL ELECTROLYSIS CELL: TESTS FOR HEXAVALENT CHROMIUM REDUCTION FROM WATER

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ABSTRACT

Background information

The possibility of Cr(VI) biological removing was investigated using a bioelectrochemical system (BES) working as a microbial electrolysis cell (MEC). In the literature, the existence of microorganisms resistant to chromium is reported, and some of them are also able to reduce it. BES takes advantage of biological abilities (microbes, enzymes) in catalysing electrochemical reactions occurring in proximity of two electrodes (anode and cathode). These systems, widely studied for the production of energy or chemicals (e.g., hydrogen, ethanol, other organic molecules), are also a promising option for wastewater and polluted groundwater treatment.

Materials, Methods and Main results

A typical "H"-shape dual-chamber system (working volume 1.2 l) was assembled joining two modified borosilicate bottles. A proton exchange membrane was located between the two bottles in order to separate the anodic and the cathodic compartments. Two cylindrical graphite electrodes (surface area about 20 cm^2) connected by a steel wire were used as anode and cathode. The system was powered by a potentiostat. Minimal medium (M9) was used in both chambers as the electrolyte and microorganism growing medium. In the cathodic solution, $KHCO_3$ (1 g/l) as the sole carbon source, hexavalent chromium (1-2 mg/l, periodically re-spiked to have different reduction tests) and an inoculum of electroactive bacteria, previously cultivated in microbial fuel cell systems. N_2 flushing in the system assured anaerobic conditions. At the biocathode a potential of -500 mV vs Ag/AgCl reference electrode was imposed. Hexavalent chromium dissolved concentration was periodically analysed by spectrophotometric method, while dissolved total chromium was determined by ICP-MS. Current intensity, Optical Density, pH and redox of the cathodic solution were also monitored during the tests. Alongside bioelectrochemical tests, open circuit controls were prepared and monitored, for comparison.

Cr(VI) reduction was observed at the end of the tests. In the Cr(VI)-reducing MEC and in the open circuit system, different Cr(VI) removal efficiency was observed during the cycles subsequent to the first. Cr(VI) removal efficiency was ascribed to the selection of a microbial community containing electro-active and Cr(VI) reducing/resistant bacteria. Current density in the system ranged between 20 and 60 mA m^{-2} during cycles, and increased up to about 100 mA m^{-2}.

Conclusions

A decrease in Cr(VI) concentration was observed in the tests, both in the polarized system and in the open circuit control. Results from microbial characterization showed that the microbial community on the surface of the electrode has been affected by the cathode polarization, being different from the biomass grown in the open circuit system.

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