# Coupling a bioelectrochemical cell with a redox flow battery for sustainable energy production and storage

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Bioelectrochemical systems (BES) are devices capable to convert chemical energy into electricity through the degradation of different organic compounds using electroactive bacteria as biocatalyst. The ability of microorganisms to form biofilms in electrode surfaces allows the transport of electrons, resultant from the oxidation of carbon sources, to an terminal electron acceptor [1].

Redox flow batteries (RFB) are electrochemical systems applied in the conversion and storage of chemical energy in electricity. Redox chemical species (in soluble form) are the main responsible for the energy storage [2]. Quinones are electroactive molecules applied in RFB because of their chemical and physical properties.

The aim of this work is to develop an innovative technology to generate and storage the energy resultant from BES. The strategy outlined is coupling a BES with a RFB that present potential to combine bioenergy production and storage in a microbially charged redox flow battery.

Firstly, a BES was studied with *Geobacter sulfurreducens* as biocatalyst to convert a quinone (2,6-anthraquinone) in its respective reduced form, acetate being the carbon source used. The BES presented current intensities around 500 $mA.m^{-2}$ and power densities around 2 $Wm^{-2}$. The reduction was assessed visually by a typical colour change (from yellow to dark red) and by cyclic voltammetry. Simultaneously, as a control, the 2,6-anthraquinone was electrochemically reduced applying and controlling the cathode potential where the reduction was also observed by colour change and by cyclic voltammetry.

In an RFB (25 $cm^2$), the quinone bioreduced in the BES and electrochemically reduced in the electrochemical cell were studied using potassium hexacyanoferrate as the second redox chemical species for discharging/charging cycles, with a constant current density of 0.2 $mA.cm^{-2}$, where coulombic, voltage and energy efficiencies were observed, as the proof of concept of the microbially charged redox flow battery.

References

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