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e-Book of Abstracts

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Design, set-up and operation of a fully-automated BES for thermophilic CO_2 reduction to acetate

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ABSTRACT

Think twice, act wise. Thinking twice before committing could avoid conflicts, reduce environmental problems, and improve social welfare. In technological research, it could avoid mistakes, reduce costs and improve results. However, complex solutions are often chosen for problems that nature has already solved in a simple way. This work gathers information over 5 years to use BES as sustainable electric batteries contributing to reduce global warming through biocatalysts, and tries to address step by step all the variables to provide a competitive alternative for the conversion of CO_2 into acetate.

From a thermodynamic approach and after multiple laboratory-scale set-ups, this new pilot plant is designed and launched with the aim of controlling crucial operating variables such as pH, electric conductivity, temperature and gases partial pressure (Figure 1). Residual heat from CO_2 emissions has the potential to be used to intensify the process, while free and abundant open cultures from conventional wastewater treatment plants can be used as biocatalysts. Besides, while in the field of renewable energy, intermittency in electricity supply is often seen as a drawback, when working with live systems it can be seen as an opportunity. Plants operate cyclically following the day, using the sun as energy and CO_2 as a carbon source. Similarly, bioelectrosynthesis can be combined with anaerobic fermentation to produce H_2 when harnessing renewable energy surplus, and use it to mediate the thermophilic conversion of CO_2 to acetate even when electricity is no longer provided. This has been shown to decrease the electricity demand by 3, increasing the acetate production per unit of electricity supplied from 42 to 138 g kWh^{-1}.

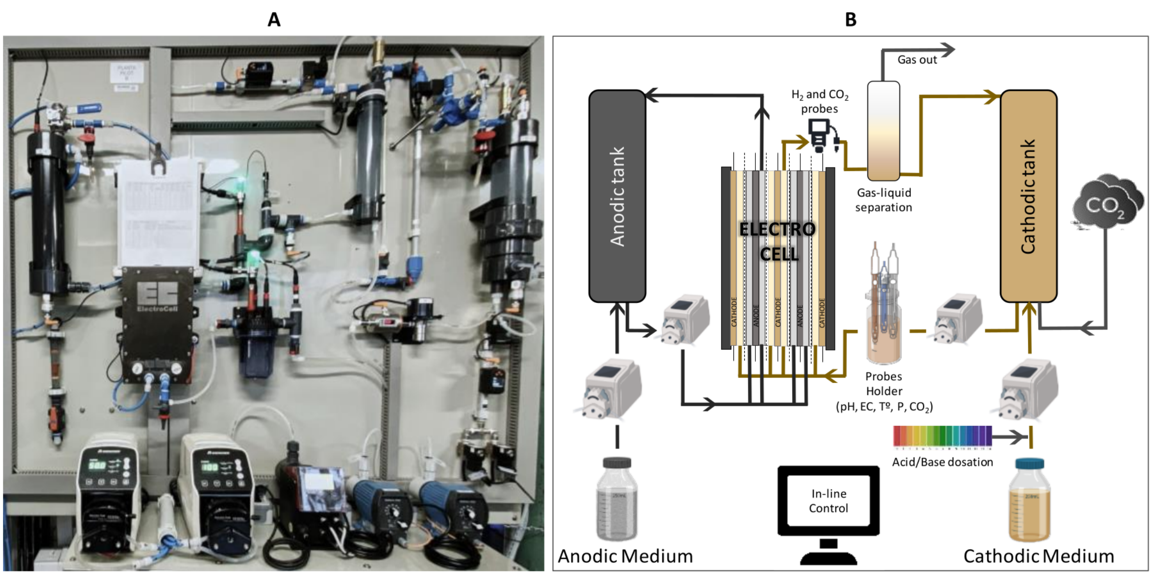

Figure 1. Real (A) and schematic (B) representation of the monitored bioelectrochemical system.

Because of the compact design, this system can be operated at the same location where the emissions are produced, avoiding losses and costs associated with transport. In this case, the transition from synthetic to real CO_2 and a tight control monitoring will determine the transformation of these systems from laboratory scale towards its implementation in the current market.

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