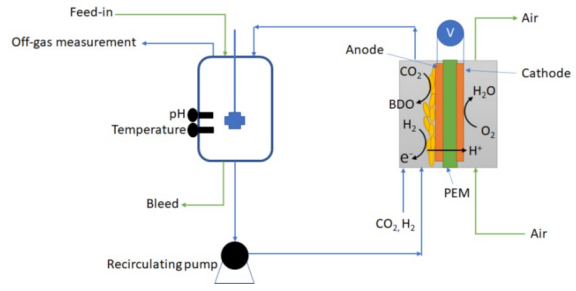
POC SUMMARY

Biotechnology and Biological Sciences Research Council

Exploring continuous, safe, and efficient production of butanediol from CO_2 in an electrogenic reactor using *Cupriavidus metallidurans* CH34

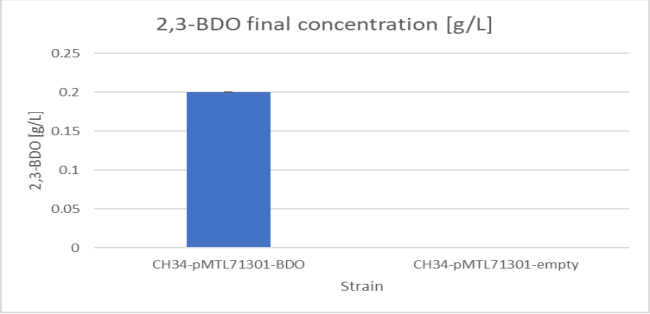
AIMS:

To design and develop an electrogenic reactor harbouring engineered Cupriavidus metallidurans CH34 strain producing butanediol from CO_2 (carbon source) and H_2 (energy source) in the anodic chamber, and O_2 as the final electron acceptor in the cathodic chamber. This aims to obviate the need for flammability considerations, removes O_2 mass transfer concerns and demonstrates a strategy for safe and efficient gas fermentation intensification based on immobilized culture.



OUTCOMES:

Experimental setup as shown in the figure was used to cultivate C.metallidurans and Geobacter strains. Similar power output was observed showing the comparable electricity generation by the CH34 strain. Engineering *C.metallidurans* to knockout the Polyhydroxybutyrate operon (PHB) was not successful. 2,3-butanediol pathway was heterologously expressed in the wildtype CH34 strain. Although some 2,3-BDO was observed in heterotrophic conditions, no 2,3-BDO was observed in the fuel cell experiments.



OUTPUT:

Results show that the proposed reactor design showcases the feasibility of the setup and comparable electricity generation with Geobacter as a control. Controlling the potential is necessary to enhance CO2 uptake on the anodic chamber. It was observed that knocking out the PHB pathway is essential to divert flux towards pyruvate derived products like 2,3-BDO in CH34 which has proven to be a bottleneck. The POC gave insights into CH34 external electron transfer capacity and by establishing efficient genetic tools, this bacteria can be showcased as an industrially potential organism in fixing waste carbon to value-added products in a biomass based anodic electron transfer setup or an cathodic based electro-fermentation.

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