NexantECA

Technology and Costs

Biorenewable Insights: Electrochemicals and Electrofuels

Electrochemicals and Electrofuels is one in a series of reports published as part of NexantECA's 2018 Biorenewable Insights program.

Overview

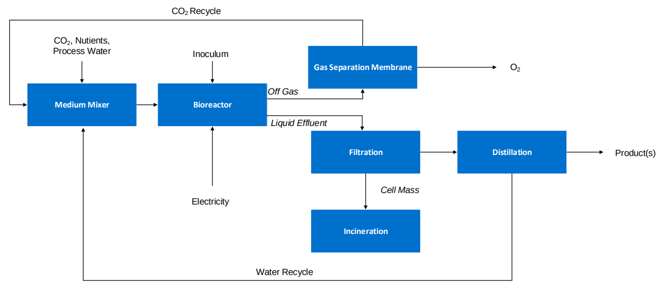
Electrofuels and electrochemicals are still at a nascent level of development, and our speculative economics show that the costs of production for the products are still quite high. Nonetheless, this technology may be useful to produce high value products (e.g., specialty and fine chemicals), while low value products (e.g., fuels) are likely to be unable to overcome the cost of capital, let alone operating costs (e.g., the cost of power). Reductions in the cost of renewable power is also increasing the attractiveness of competitively supplying these technologies with clean power. However, if the economics can be made viable, drop-in electrofuels would have the strategic and logistic advantage of utilizing renewable electricity in existing ICE platforms rather than converting to electric vehicles with batteries.

Technologies

Generally, electrofuels and electrochemicals are a form of microbial electrosynthesis technology, which uses electricity to convert carbon dioxide (or other renewable carbonaceous feedstocks) into fuels and chemicals. Mimicking photosynthesis, carbon dioxide and water are combined to produce organic compounds, with oxygen as a byproduct. As a result, electrofuels and electrochemicals can be a carbon neutral source of energy and chemicals—depending upon the source of electricity.

In traditional reactors, where the anode and cathode chambers are separated with a proton-selective membrane, the rates and columbic efficiencies of microbial electrosynthesis remain high when electron delivery at the cathode is powered with a direct current power source. There has also been some study of membrane-less reactors with a direct-current power source with the cathode and anode positioned to avoid oxygen exposure at the cathode, which could make scale up significantly easier. Much of electrofuels and electrochemicals are still quite nascent and at the academic level.

Microbial electrochemical systems (MECs) use microbes to catalyze biochemical reactions at the electrode-microbe interface. In microbial electrosynthesis (MES), electrically driven microorganisms (e.g., cathodophilic- or metal-oxidizing microorganisms) are used as biocatalysts to convert CO_2 to value-added chemicals, biomass, or biogas using the cathode potential.



Process Economics

Cost of production models for USGC, Brazil, Western Europe and China are shown for:

- Formic Acid
- 3-HPA
- Oxalic Acid
- Butanol
- Acetic Acid
- Ethylene Glycol
- Propionic Acid
- Hydrogen
- Ethylene
- Ethanol
- Mixed Alcohols

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Technology and Costs comprises the Technoeconomics – Energy & Chemicals (TECH) program, the Biorenewable Insights program (BI), and the new Cost Curve Analysis. These programs provide comparative economics of different process routes and technologies in various geographic regions.

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