Operational Energy From Seawater

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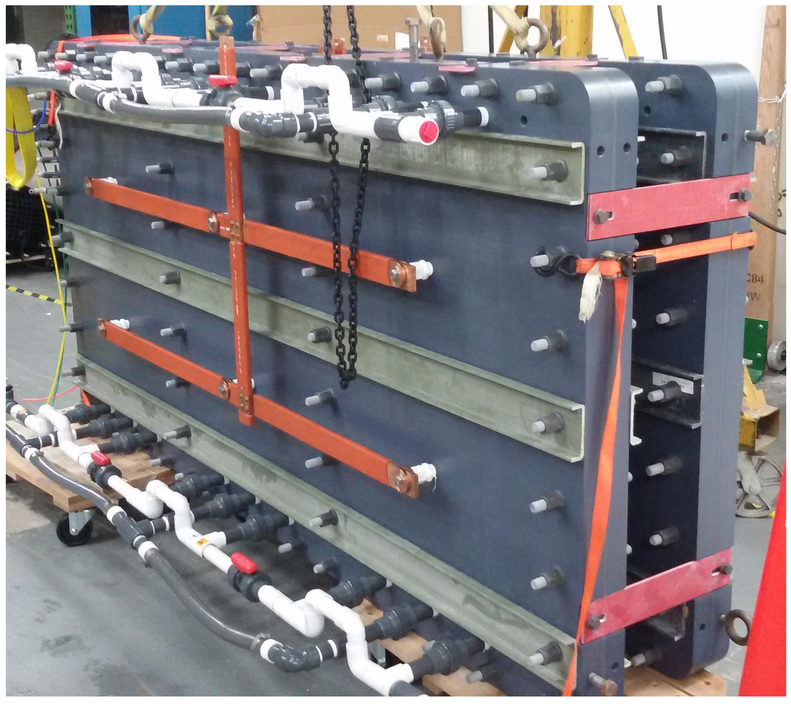
Background:

The U.S. defense strategy requires a military with the ability to respond swiftly to a broad range of global missions. To meet these operational demands, ships and aircraft must be ready at all times. This NRL program provides a future technological capability of producing operational fuel deep in the battle space, as needed to support persistent and sustainable mission and warfighting capabilities. This presentation will discuss the development of NRL's electrolytic cation exchange module (E-CEM) prototype that produces CO_2 and H_2 from seawater as feedstocks. Along with the scaled-up demonstration of these feedstocks converted to operational hydrocarbon fuel. The challenges and the benefits associated with the integration and demonstration of these modular technologies will be key to their future implementation.

The Technologies:

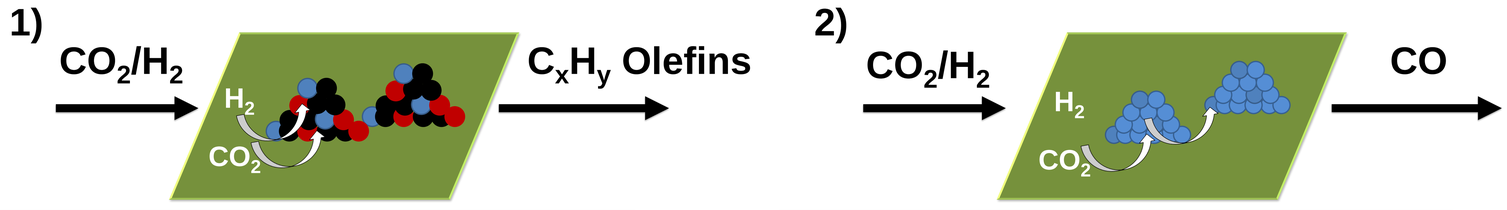
NRL Electrolytic Cation Exchange Moduel (E-CEM)



- 92% recovery of H_2 and CO_2 from seawater in a 3:1 ratio H_2 to CO_2
- A 50 x scaled-up prototype that processes 36,000 gal/day seawater
- The E-CEM units produce more than enough feedstock to make 1 gallon fuel/day
- Target power consumption 4.3 kWhr/m^3 H_2

Modular Thermochemical Reactor

Two Catalyst Systems Tested in Modular Thermochemical Reactor



- 300 x scale-up in hydrogenation of CO_2
- CO_2 conversion 69% by recycling a portion of the product stream
- Selectivity as high as 79% in favor of higher hydrocarbons

- 10,000 x scale-up in hydrogenation of CO_2
- CO_2 conversion 20% on a single pass and selectivity to CO from 93% to 100%
- CO_2 conversion 47% and selectivity to CO 97% by recycling a portion of the product stream

Next Steps

- Optimize future E-CEM prototype size, weight, and power consumption
- Down select catalyst approach used for liquid hydrocarbon fuel production
- Integrate E-CEM and chemical reactor to demonstrate up to 1 gallon/day of liquid hydrocarbon fuel production