

Hydrogen production via mediated electrolysis of biomass

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Background

Mediated Electrolysis of Biomass

Thermal Digestion + Oxidation of Reduced Polyoxometalate (POM) (in this case Phosphomolybdic Acid [PMA])

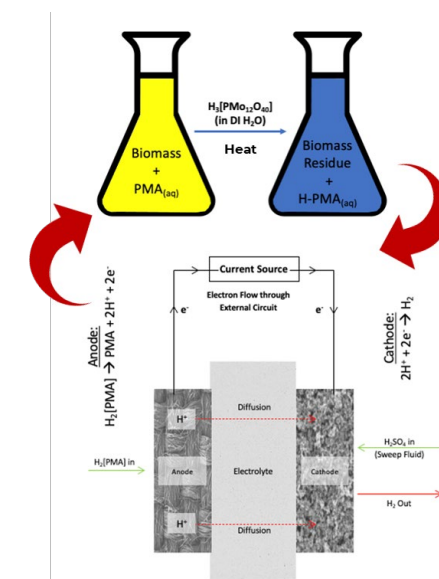
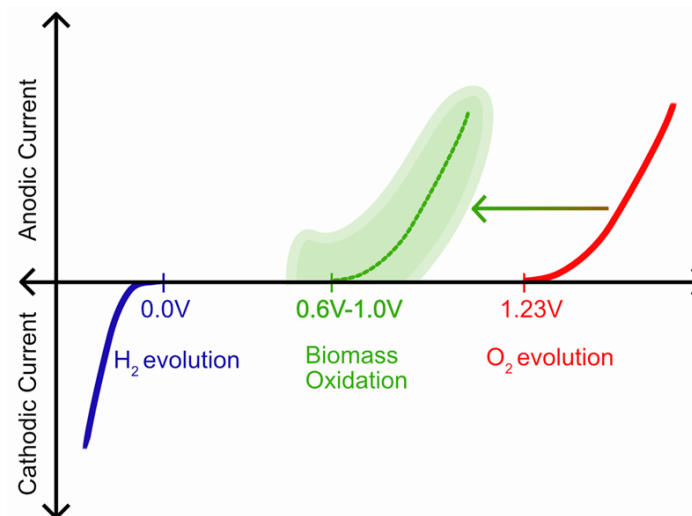
- Direct wet waste processing
- Lower cell voltage compared to water electrolysis
- Low temperature operation
- Ambient Pressure

Thermal digestion:

- Biomass + x H₂O + y POM_(OX) → Oxidized products + CO₂ + y H-POM_(Red)

Cell reactions:

- H-POM_{Red} → POM_(OX) + H⁺ + e⁻ (Anode)
- H⁺ + e⁻ → ½ H₂ (g) (Cathode)



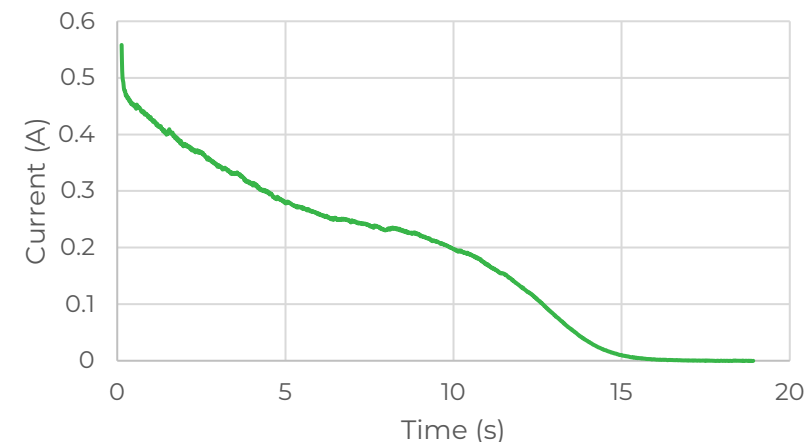
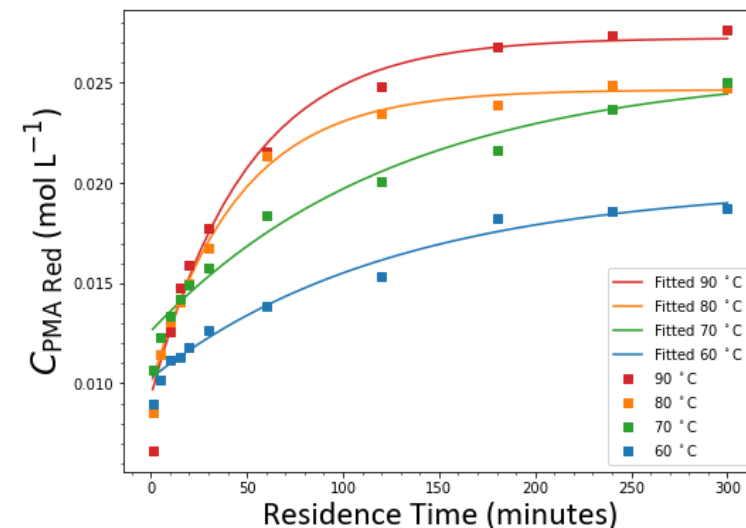
“Continuous flow Concept”



- Digestion of biomass reaction is carried out currently in glassware with condensers. Solutions move to reservoirs when fully reduced
- From the reservoir, the POM is oxidized by the cell, producing Hydrogen.
- New biomass is then fed into the digester for the oxidized POM to start digesting after it is pumped back into the digester

Balance of Digester and Electrolyser

- As an example, after 1 hr, roughly 70% reduced PMA available. The further reduced the PMA, the higher the current we see in the electrolyser.
- As the PMA is oxidised, the current observed (hence rate of H₂ produced) decreases (if you hold a voltage).
- As the system is scaled up, a balance of digester to electrolyser needs to be factored in (limit the electrolyser to the rate of reduced PMA production).
- We can control the current (and hence hydrogen output) to a constant level to match the digestion process (to be simulated)



Calculations for energy saving

Example with the small cell

- Average 1.53W
- Faradaic Efficiency = 96% (19mls / 19.8mls (theory))

28.17kwh per 1 kg Hydrogen

(Typical Low Temperature Water Electrolysis = 52 kwh per 1 kg hydrogen)¹

For low-temperature electrolysis, electricity including grid fees constitute 66% of the total LCOH of 7.1 EUR/kg¹.

Our system uses about half the energy of a conventional water electrolyser to produce hydrogen. If the overall system were to use waste heat from another process, the cost of heating the PMA can be nullified.

Get in touch

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