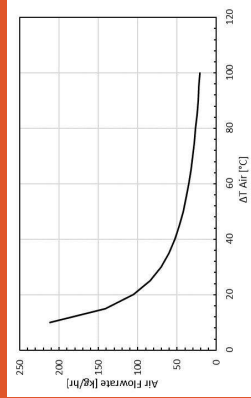


Compression and Cooling

- Hydrogen is harder to compress due to its small molecular size and tendency to fit in microcracks
- Each compressor will at maximum flow will handle **0.65 kg/hr** and will increase the pressure by a factor of **6-8**
- Compressors lose efficiency and can shut down at lower flow rates called **turndown ratio**. to combat this effect batteries can be used of the system can be temporarily shut down
- Air cooling** will be used for the first two heat exchangers to reduce the amount of water needed to reach the final pressure of 300 atm



- Cooling water** at 20°C will be fed through the last heat exchanger at 0.12 kg/hr
- The **effluent gas stream** will be stored at 300 atm and 2.5°C for safe storage

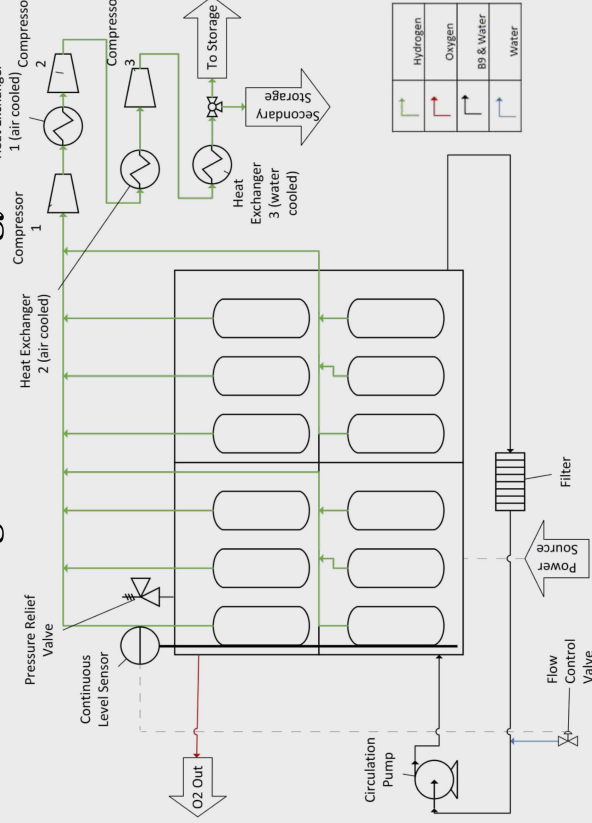
FUN FACT: It's estimated that Hydrogen makes up 90% of all atoms in the UNIVERSE!



Oregon State University

HYDROGEN COMPRESSION FROM RENEWABLES

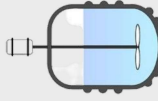
Hydrogen production and compression via new environmentally friendly electrolyte technology using renewable energy



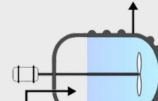
Batch to Continuous

- Cores** → **Cassettes** → **Blades** → **Pod**
- Designed to be **modular and mobile**
- Cassettes pressurized to 2 atm
- Hydrogen compressed to 300 atm
- Fully automated** system for minimal maintenance
- B9 is a benign electrolyte and environmentally friendly
- Only inputs are water, electrolyte, and electricity!**

BATCH



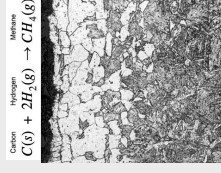
CONTINUOUS



Safety

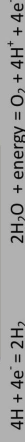
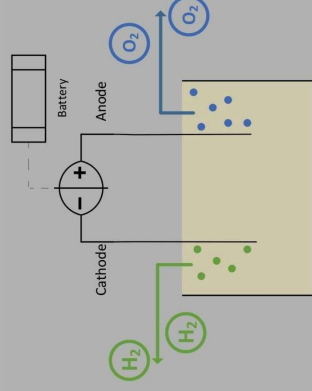
- High temperature hydrogen attack leads to **embrittlement**
- H2 and O2 sensors to alarm in case of leaks
- Pressure relief valves** to ensure no overpressurization
- High pressure vessels require thick walls

High temperature hydrogen attack occurs at approximately 400 °C. Hydrogen's size allows it to diffuse into metals and react with carbon in the metals and leads to catastrophic failures. **Material selection and cooling system keeps this process safe and reliable!**



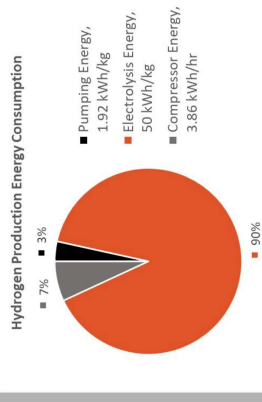
Why Hydrogen?

- Long term** energy storage without erosion
- Green energy** when renewables aren't producing (night for solar, or windless days for wind)
- Only water is produced during combustion
- Greater energy density** than gasoline (120 MJ/kg vs 46 MJ/kg)
 - 5 kg of Hydrogen → 300 miles
 - 5 kg of gasoline → 51 miles (at 30 MPG)
- Modular hydrogen** decreases shipping expenses



Energy Analysis

- Estimated **55.8 kWh/kg** Hydrogen energy input required
- Approximately 1800 sq ft of solar panels required per pod
- Paying for Electricity? **\$5.58/kg** Free Electricity? Free H₂! (ignoring cap cost)



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