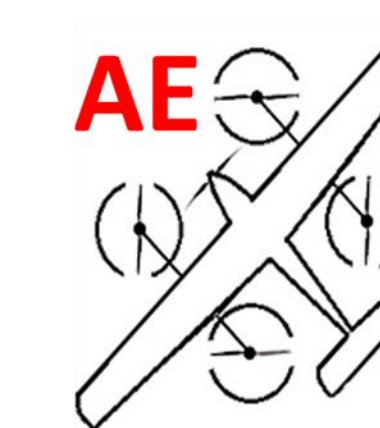
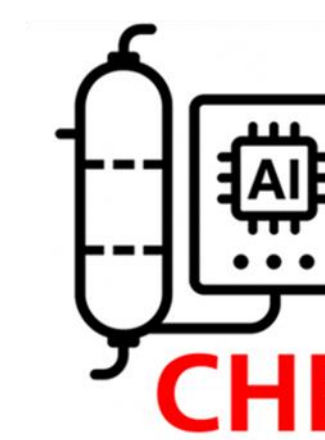


CubeSat-Based Life Support System for Carbon Dioxide Capture and Air Purification

Saleh Al-Ghamdi, Ibrahim Al-Fawzan , Sari Al-Mofleh

Coach: Dr. Mohammed Alam



3



Introduction

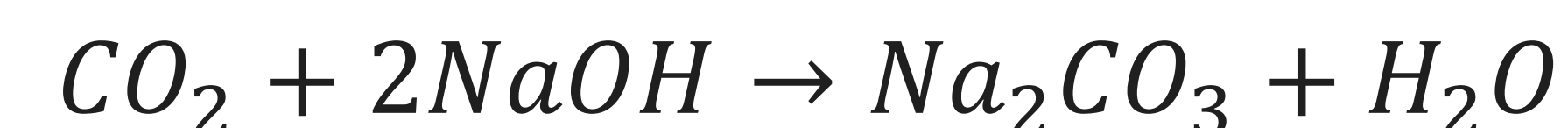
- Long-duration space missions require sustainable, closed-loop life support systems to minimize cargo weight.
- This project introduces a compact CubeSat-sized prototype designed to recycle metabolic waste (Carbon Dioxide) into breathable Oxygen (O_2) and Hydrogen fuel (H_2).
- The system integrates chemical absorption with water electrolysis to ensure continuous resource regeneration in a microgravity-compatible design.

Process Description

1. Carbon Capture:

CO_2 gas is introduced into a reaction vessel containing Sodium Hydroxide

Reaction:



2. Filtration:

Solid Sodium Carbonate (Na_2CO_3) is removed, yielding purified water.

3. Electrolysis:

The purified water is pumped into a PEM Electrolyze.

Output: Oxygen is vented for breathing; Hydrogen is stored for energy use.

Specifications & Data

Component/Parameter	Value / Specification	Function
Capture Agent	Sodium Hydroxide ($NaOH$)	Absorbs CO_2 to create water.
Electrolyze	PEM Stack (Proton Exchange)	Splits water into H_2 and O_2
Operating Voltage	[Insert Voltage 5V - 12V]	Power supply for electrolysis.
Filtration	In-line Mesh/Membrane	Separates solid precipitates.
Target Output	Oxygen (O_2)	Life support (Breathing).
By-Product	Hydrogen (H_2)	Potential fuel source.

Constraints & Design Basis

- Dimensions:** The system must fit within a standard CubeSat form factor
- Safety:** Zero leakage tolerance for Hydrogen and Sodium Hydroxide
- Efficiency:** Maximized Oxygen recovery with minimal power consumption.
- Environment:** Designed to withstand vibration and operate in a closed-loop environment.

Conclusion

This project developed a functional CubeSat prototype that converts CO_2 into breathable Oxygen and Hydrogen fuel. By successfully integrating chemical absorption with electrolysis, the system validates a compact, closed-loop solution for sustainable life support in long-duration space missions

Process Diagram

