Current methods of solar thermal energy storage use sensible or latent heat. This prevents the ability to store energy for long periods of time and requires large scale processes to be feasible. A proposed solution is chemical energy storage in a salt dehydration reaction. These salts can store energy for an indefinite period of time. Applications include heating, cooking, and water sterilization for energy impoverished areas.

Calcium chloride (CaCl₂) was the salt chosen for testing because it is inexpensive, obtainable, and safe.

\[
\text{CaCl}_2(s) + 6\text{H}_2\text{O}(l) \rightleftharpoons \text{CaCl}_2\cdot 6\text{H}_2\text{O}(s) + \text{Heat}
\]

Equation 1. Hydration reaction of anhydrous CaCl₂.

### Objectives

- Small scale, long term solar energy storage
- Solar collector design with minimal tracking
- Operation times of less than three hours

### Methodology

Calcium chloride is impregnated into a “salt vehicle”, graphite matrix, to increase surface area for both hydration and dehydration processes. These salt vehicles are dehydrated with a Mylar solar concentrator to focus solar radiation onto an evacuated tube dehydration chamber. The evacuated tube minimizes heat loss, allowing for high dehydration temperatures to be obtained.

### Results

- Current design achieved 217 °C, and allows salt dehydration to a monohydrate state within approximately one hour.
- The use of only an evacuated tube without concentrated solar radiation achieved the dihydrate state at 45 °C in under ten minutes of operation time.
- The anhydrous state has an energy storage of 336 MJ/m³ of salt vehicle. This would result in needing approximately 149 m³ of salt vehicle to heat a home annually.

### Conclusion

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### Future Work

- **Alternative salts**
  - Magnesium sulfide, magnesium hydroxide, and magnesium nitrate have different dehydration temperatures, heats of hydration, and energy densities and are being explored as options for increasing energy storage.
- **Solar collector improvements**
  - Measure mass loss of water over time

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