Comparative Analysis of Dual- and Single-Media Thermocline Tanks for Energy Storage (CSP-5)

A joint India-U.S. research consortium funded under the *Joint Clean Energy Research & Development Center (JCERDC)*

Scientific Achievement:

We use numerical simulation to perform a detailed thermal analysis of thermocline tanks with molten salt and quartzite rock (dual media), and with only molten salt (single media). Both tank designs have high thermal performance: greater flow disturbance is observed in the single-media tank, and diffusive thermal losses inside the dual-media tank.

Significance and Impact:

Inclusion of low-cost filler materials in thermocline tanks has the potential risk of thermomechanical failure by successive thermal ratcheting. Tanks with only molten salt can be more reliable, but internal mixing can reduce the quality of stored thermal energy. Thermal assessment serves to determine applicability of both energy storage alternatives in concentrating solar power plants.

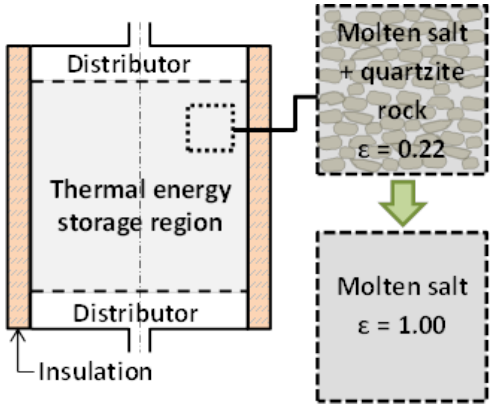
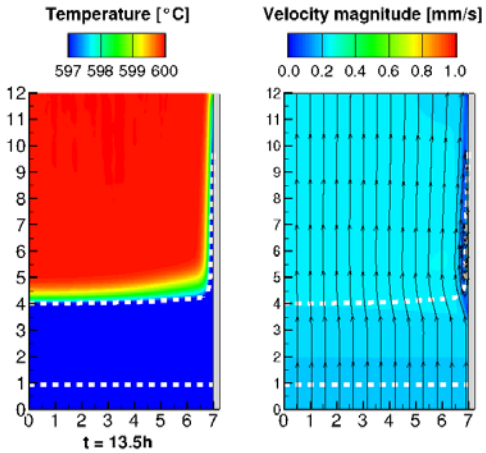


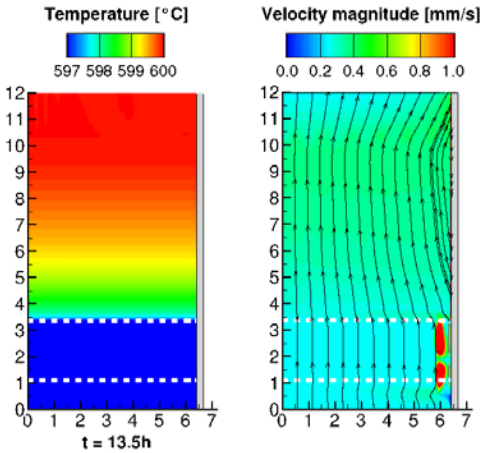
Illustration of dual- and single-media thermocline tank design

Research Details:

- Adiabatic and non-adiabatic thermal conditions are considered; behavior analyzed under cycles with and without dwell time.
- Two-dimensional axis-symmetric numerical simulation.
- Effective thermocline thickness during cycle is used as metric of thermal stratification.
- Energy storage performance is assessed with first- and second-law efficiencies.
- Mechanistic explanation of thermal behavior.



Dual-media thermocline tank



Single-media thermocline tank

Publication(s): C. Mira-Hernández, S. M. Flueckiger, S. V. Garimella , "Comparative analysis of single- and dual-media thermocline tanks for thermal energy storage in concentrating solar power plants," *Journal of Solar Energy Engineering (In Review).*

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