Assessment of Thermocline Tank Energy Storage with Phase-Change Materials (CSP-5)

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

Scientific Achievement:

An efficient reduced-order numerical model of thermocline energy storage with phase-change materials (PCM) is integrated to a system-level model of a concentrating solar power plant (CSP). A cascaded distribution of phase-change materials with different melting temperatures can yield significant improvement in plant performance.

Significance and Impact:

Thermocline tanks with latent heat inclusion have the potential for increased energy density, but require careful consideration of the PCM properties and distribution to avoid adverse performance. The parametric study serves to evaluate this alternative and establishes criteria for thermocline tank design.

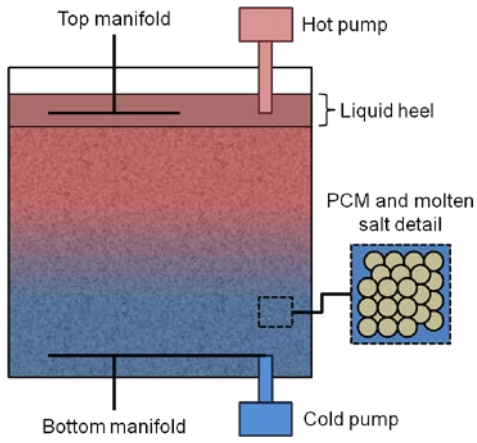
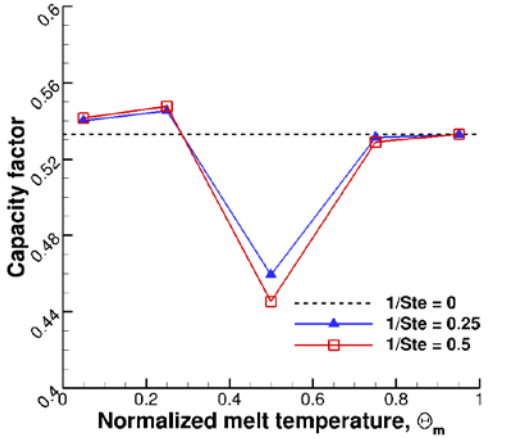


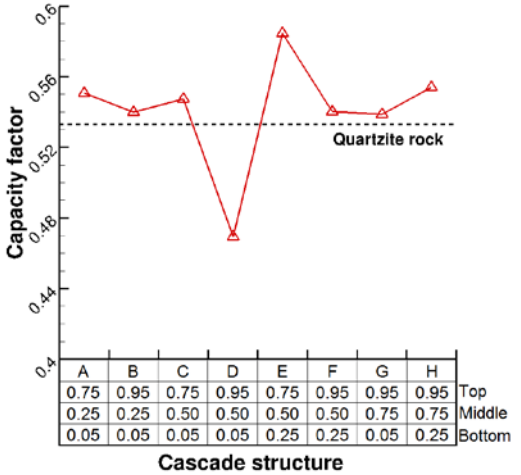
Illustration of thermocline tank with PCM

Research Details:

- One-dimensional user-generated numerical model of the thermocline tank with latent heat is integrated to system model for year-long simulations.
- Parametric study with different melting temperatures and heats of fusion.
- Conventional thermocline tank with quartzite rock is used as benchmark.
- Performance is assessed in terms of power tower plant annual indicators, such as the capacity factor.



Effect of melting temperature and heat of fusion on power plant performance



Annual performance of CSP plant with cascade structure

Publication(s): S. M. Flueckiger and S. V. Garimella, "Latent-Heat Augmentation of Thermocline Energy Storage for Concentrating Solar Power – A System-Level Assessment," Applied Energy, Vol. 116, pp. 278-287, 2014.

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