Numerical Analysis of Latent Heat Thermal Energy Storage using Encapsulated Phase Change Material for Solar Thermal Power Plant (CSP-5)

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

Scientific Achievement:

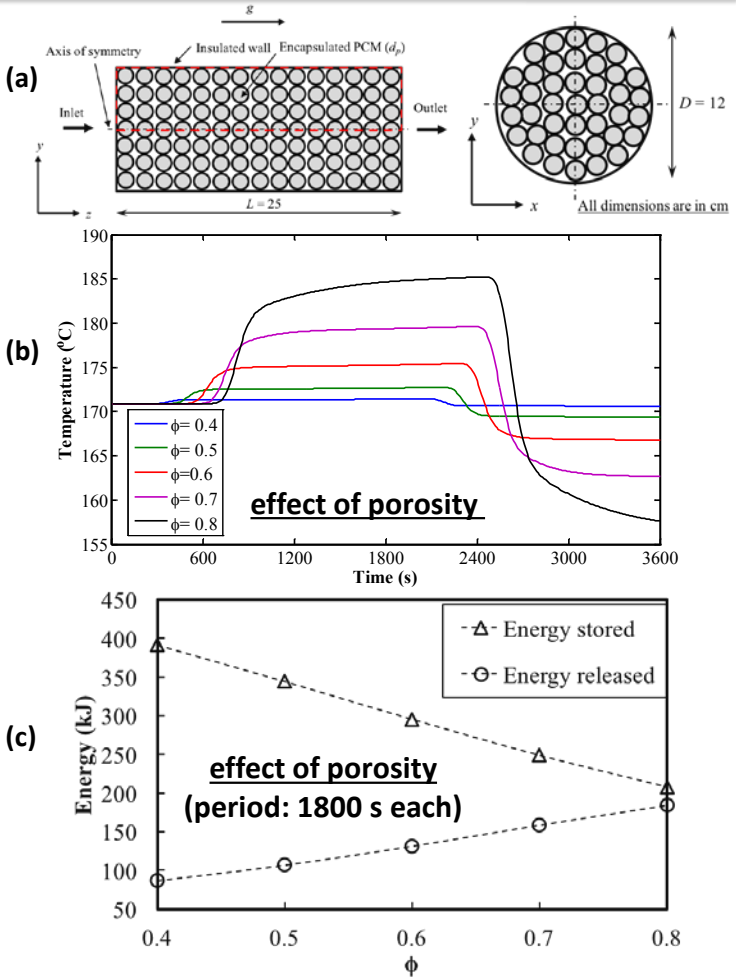
We investigated transient response of a packed-bed latent heat thermal energy storage system (LHTES) in removing fluctuations in the heat transfer fluid (HTF) temperature during the charging and discharging period. To evaluate the system performance, we computed the overall effectiveness and transient temperature difference in HTF temperature in a cycle for different geometrical and operational parameters.

Significance and Impact:

The thermal performance of this type of LHTES packed with spherical encapsulated phase-change materials (PCMs) is superior compared to other thermal energy storages; however, the pressure drop is an issue. The mass flow rate, porosity, system dimension, and encapsulation diameter can be varied to optimize the storage system for real applications.

Research Details:

- We developed a 2-D axisymmetric model in ANSYS Fluent using flow equations for HTF and a two-temperature non-equilibrium energy equation for heat transfer, coupled with an enthalpy method to account for phase change in PCM.
- We found that the increase in porosity and storage diameter for a fixed volume of LHTES reduces the storage system ability to reduce the fluctuations in HTF temperature to a large extent.



(a) Model geometry, (b) effect of porosity , (c) energy stored and released during charging and discharging periods

Publication: Kunal Bhagat, Sandip K. Saha, Numerical analysis of latent heat thermal energy storage using encapsulated phase change material for solar thermal power plant, Renewable energy, 2016. *DOI*: **10.1016/j.renene.2016.04.018**.

Contact(s): Kunal Bhagat (kpb2509@gmail.com)
Sandip K Saha (sandip.saha@iitb.ac.in)