System-Level Simulation of a Molten-Salt Thermocline Tank

Student: S. M. Flueckiger Faculty: S.V. Garimella

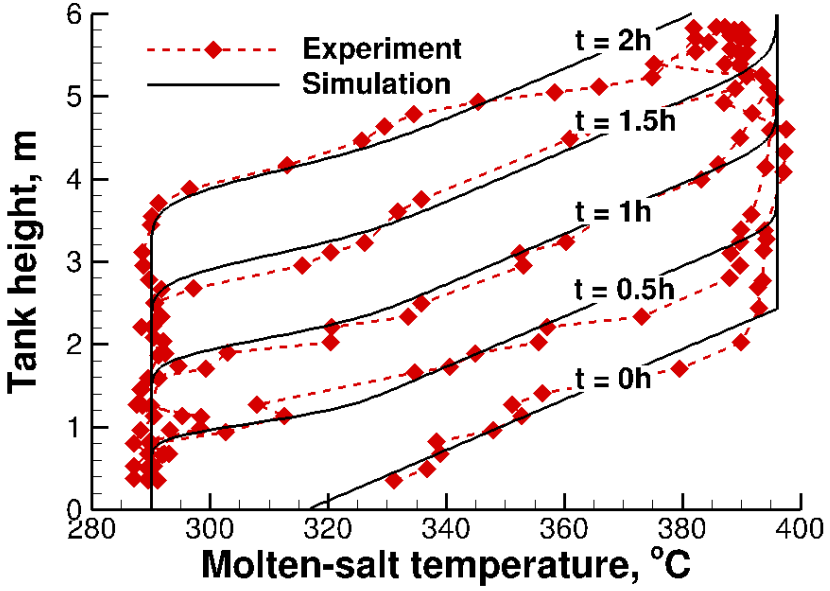
PURDUE UNIVERSITY

Motivation

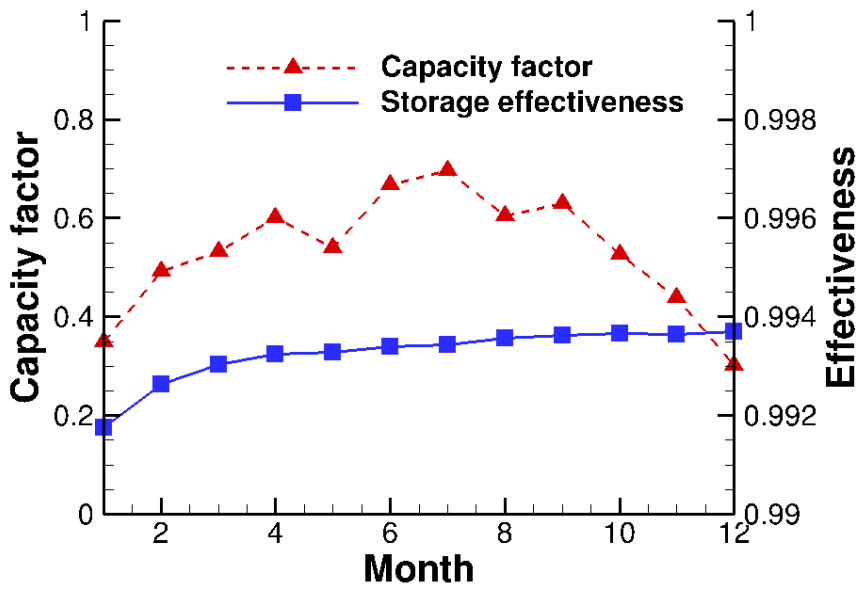
- Thermocline tanks offer low-cost thermal energy storage for concentrating solar power (CSP)
- Store excess heat transfer fluid (molten salt) at both **hot** and **cold** states inside a single tank, with vertical stratification sustained via buoyancy forces.
- Investigate thermal stability and storage performance under realistic operating conditions

Numerical Analysis

- Developed a thermocline tank model with low computing cost using finite-volume method
- Combined tank model with a system-level CSP plant model to simulate storage performance using actual sunlight data and realistic plant operating conditions
- Thermocline tank exhibits high storage effectiveness throughout a complete year of plant operation



Model validation with experimental data recorded during a discharge (Pacheco, *JSEE*, 2002)



Monthly power plant capacity factor and thermocline tank storage effectiveness