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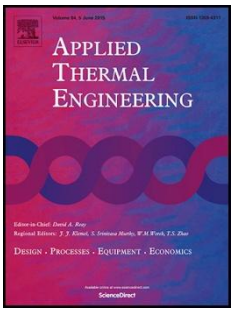

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Performance modeling and parametric study of a stratified water thermal storage tank

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Highlights

- A 1-D transient strati_ed water thermal storage tank model with 10 nodes is created.
- Node-mixing methods e_ciently predict temperature pro_les given inlet conditions.
- Parametric study conducted for hot/cold ow rates and heat exchanger con_gurations.
- Buoyancy-induced mixing, a_ected by heat exchanger location, reduced strati_cation.
- Method suggested for performance prediction and for integration with other models.

Abstract

Thermal energy storage (TES) can significantly increase the overall efficiency and operational flexibility of a distributed generation system. A sensible water storage tank is an attractive option for integration in building energy systems, due to its low cost and high heat capacity. As such, this paper presents a model for stratified water storage that can be used in building energy simulations and distributed generation simulations. The presented model considers a pressurized water tank with two heat exchangers supplying hot and cold water respectively, where 1-D, transient heat balance equations are used to determine the temperature profiles at a given vertical locations. The paper computationally investigates the effect of variable flow-rates inside the heat exchangers, effect of transient heat source, and buoyancy inside the tank induced by location and length of the heat exchangers. The model also considers variation in thermophysical properties and heat loss to the ambient. TES simulation results compare favorably with similar 1-D water storage tank simulations, and the buoyancy model presented agrees with COMSOL 3-D simulations. The analysis shows that when the inlet hot fluid temperature is time dependent, there is a phase lag between the stored