Abstract

A research facility with solar thermal collector system and a water-saturated, sand-based seasonal thermal energy storage (SSTES) is used to provide space heating and domestic hot water heating to homes in cold climates. A 3D finite difference model of the heat transfer in and around the SSTES is presented and validated with measured data. The SSTES has lost moisture over time, making its thermal properties difficult to estimate. Additionally, the experimental data shows the SSTES losing heat at twice the expected rate, potentially due to incorrect thermal parameters from the manufacturer and the SSTES insulation being damaged or degraded. The final numerical model was validated over a 163-day period where energy was being injected into and extracted from the SSTES. It was found that the seasonal performance of the SSTES could be predicted by a conduction-only heat transfer model, and this model is suitable to be included in BPS tools.

The research facility and experiments that were conducted will also be described and the performance of the solar thermal combisystem with underground storage will be analyzed.

Short Bio

Rebecca is a PhD candidate in Mechanical Engineering at Carleton University. After completing her Bachelors and Masters degrees in Chemical Engineering (University of Alberta, Ecole des Mines de Paris), she worked in industry for a few years, designing industrial heat exchangers, troubleshooting tailings systems in the Alberta oil sands, and working as a consultant in the sustainable building industry.

She is currently researching sand-based seasonal thermal energy storage for residential homes. Rebecca loves getting people excited about heat transfer, physics, and all things science-related. She is an avid yogi, balcony gardener, and Professional Engineer (Alberta).