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Experimental Results and Modeling of Thermal Energy Storage System

The inconsistent and unpredictable nature of sustainable energy sources is a major challenge which still needs to be managed. To address this issue and minimize energy loss in concentrated solar plants, thermal energy storage (TES) vessels are used to hold energy when the supply is higher than the demand. TES units work by storing the excess thermal energy in packed beds of varying materials. This research focuses on increasing the efficiency of packed bed TES units. The main objective was installing and commissioning the TES vessel. First, a system which met the physical thermal design constraints of the vessel was designed. Then, before assembly each piece of the system needed to be verified for proper functioning and is essential to the continued success of the lab. After confirming accurate behavior of the utilities and process control, a baseline test showing the thermal effects of 5 standard cubic feet per minute (SCFM) of 200°C air through the vessel and the losses when the system was reversed was recorded and analyzed. Additionally, using Star-CCM+ a more physically realistic model of the flow through the vessel using the discrete element method was created. The long term focal points were performing experiments with multi-component packed beds to find an optimum system for TES, and updating the discrete element method pore scale numerical model. A reliable, and more efficient, TES unit would save money for the energy companies, increase the supply of renewable energy power, and decrease the cost of sustainable energy sources.

Acknowledgements: Mohammad Mahdie (MSU Undergrad Student) - Mechanical & Industrial Engineering, Dinal Perera (MSU Undergrad Student) - Mechanical & Industrial Engineering