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Comparison between the single-PCM and multi-PCM thermal energy storage design

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Abstract: One way of improving the performance of a latent thermal energy storage system is by implementing the multiple PCM design. In this design, spherical capsules filled with phase changes material (PCMs) of different thermo-physical properties are used. The capsules are packed in the bed at different sections based on the PCM melting temperature. The melting temperature variation is selected to match the heat transfer fluid (HTF) temperature profile along the bed. This is to maximize the heat transfer rate between HTF and PCMs. Multi-PCM design is found to increase the charging and discharging rate, thus improving the dynamic performance of the latent heat thermal energy storage system (LTES) as reported by many researchers. However, the degree of improvement as the number of stages increases needs more insight investigation and understanding. In this work, a latent thermal energy storage system using spherical capsules filled with PCMs of different properties at different sections along the bed is considered. Single- PCM design and multi-PCM design of two and three stages are investigated. The performance of the systems is calculated and presented in terms of charging and discharging rate, rate of heat transfer, and storage capacity. The results indicate that as the number of stages increases the multi-PCM thermal energy storage (TES) performance increases. However, using more than three stages does not add any appreciable improvement.