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MODELING OF CONSTRAINED MELTING IN A RADIALLY FINNED LATENT THERMAL ENERGY STORAGE UNIT

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ABSTRACT

Phase-change materials (PCMs) are able to store large amounts of heat but have low thermal conductivity. In order to enhance the rate of heat transfer into PCMs, one of the most common methods is the use of fins which increase the heat transfer area that is in contact with the PCM. The present work deals, both experimentally and numerically, with a latent heat thermal energy storage (LHTES) device that uses a radially finned tube. A heat transfer fluid (HTF) flows through the tube and heat is conducted from the tube to the fins which are in contact with the bulk of the PCM inside a cylindrical shell. The thermal storage charging/discharging process is driven by a hot/cold HTF inside the tube that causes the PCM to melt/solidify. First, the experimental setup is shortly described. Then, the numerical model is verified with a sensitivity test for the grid size and the time-step. The model is also validated by visual comparison with the experimental results. The numerical model is then used to study the effect of the HTF temperature on the melting rate. It is found that the results can be generalized by a dimensional analysis.