

Comparison of Numeric Models for the Simulation of Molten Salt Thermoclines with Filler under Different Applications

Christian Odenthal¹, Freerk Klasing¹ and Thomas Bauer¹

¹*German Aerospace Center (DLR), Linder Höhe, 51147 Köln*

To date, two-tank molten salt systems mark the current state-of-the-art for large scale thermal energy storage applications. Single-tank thermocline systems with filler promise significant cost reductions, but are still under development. Publications dealing with upscaling have utilized various models with different simplifications or assumptions. Most of these models have been developed for gas through-flow regenerator storage systems such as cowper stoves. The applications range from simple sizing calculations up to annual simulations. So far, only a few publications deal with the different outcome of those models. Particularly for molten salt applications, there has been no comparative work.

To resolve this shortcoming, a comparative study of four one-dimensional models suitable for packed bed molten salt storage systems is presented. The investigated models are the single phase model, the Schumann model, the continuous solid phase model and a recently developed bidisperse model. Based on practical considerations, different representative cases of application are defined for the comparison. The outcome of the simulations shows significant differences depending on the case of application. For example, in sizing applications some physical effects have a significant impact, but can be neglected in annual simulations. The total stored energy can differ more than three percent over the course of an annual simulation. The outcome of this work provides an overall contribution to a better understanding of single tank molten salt storage simulation with filler.

Keywords: Molten Salt; Thermal Energy Storage; Model Comparison;