Thermal cyclic stability analysis of porous heat storage materials

Henok Hailemariam[1 *], Frank Wuttke[1]

[1] Geomechanics and Geotechnics, Kiel University, Kiel, Germany
* henok@gpi.uni-kiel.de

Abstract

Assessing the thermal cyclic stability of energy storage materials is of ut-most importance in the design and overall serviceability of sensible heat stor-age systems. In particular, care should be taken to ensure that the plastic strains accumulated upon short and long term cyclic operations are within the design limits, thus preventing critical failure of the different components of the heat storage system. In this study, the thermal cyclic stability of a commercial cement-based porous heat storage material is analyzed in water-saturated conditions by performing heating/cooling cycles in the temperature range from 20 to 80°C with a newly developed cyclic thermo-mechanical de-vice. The thermo-mechanical device produces a homogenously linear temperature distribution across the specimen, thus recreating the actual heat flow and distribution within sensible heat storage materials upon heat load-ing/unloading operations. The cyclic thermal, peak induced and accumulated plastic strains due to charging/discharging operations of the sensible heat storage material are studied for several lower and upper temperature cycle limits (20-40°C, 20-60°C, 20-80°C and 60-80°C) and dwelling periods (0, 10, 40 and 120 minutes), and the results are analyzed in terms of the intrinsic porous medium structure and cementation behavior.