

New insights into the corrosion mechanism between molten nitrate salts and ceramic materials for packed bed thermocline systems: A case study for steel slag and Solar salt

Iñigo Ortega-Fernández ^a✉, Yaroslav Grosu ^a, Ainhoa Ocio ^b, Pedro Luis Arias ^b, Javier Rodríguez-Aseguinolaza ^a, Abdessamad Faik ^a✉

^a CIC Energigune, Albert Einstein 48, 01510 Miñano, Álava, Spain

^b Escuela de Ingeniería (UPV/EHU), C/Alameda Urquijo s/n, 48013 Bilbao, Bizkaia, Spain

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Highlights

- The valorisation of **steel slag** as low cost TES material is proposed.
- The compatibility between a **molten** nitrate salt (Solar Salt) and steel slag is investigated.
- All **corrosion** mechanisms occurring between the salt and the slag are not detectable with XRD and SEM.
- A deeper analysis of the salt and slag chemical compositions revealed a migration of cations.
- The migration mechanism leads to the modification of the thermo-physical properties of the salt.

Abstract

Thermal energy storage (TES) systems based on packed bed arrangements are proven to be a very promising route to decrease the levelized cost of electricity (LCOE) in concentrated solar power (CSP) plants. However, the compatibility between the TES material and the heat transfer fluid (HTF), which operate in direct contact, is known to be a major limitation for such configuration. In this regard, the compatibility between a molten nitrate salt (Solar salt) and a ceramic by-product from the steel production, the steel slag, is investigated in this work. The obtained results show that the standard criteria used for determining any chemical incompatibility phenomena like the formation of a corrosion layer or the appearance of structural modifications, are not enough to draw a conclusion on the materials compatibility. A deep analysis of the TES material and the HTF chemical compositions revealed a migration of cations from the slag to the salt, and the formation of nitrites in the latter boosted by the presence of the slag. These two mechanisms lead to the modification of the thermo-physical properties of the salt.