

Research Paper

Natural and by-product materials for thermocline-based thermal energy storage system at CSP plant: Structural and thermophysical properties

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Highlights

- Characterization and evaluation of 3 filler materials for packed bed TES system.
- Excellent energy density of Magnetite compared with other ceramic materials.
- BOF-Slag, Magnetite and River rock are appropriate materials for TES applications.

Abstract

Thermal energy storage (TES) technology is currently considered as a key solution to improve the performance of Concentrated Solar Power (CSP) plants in terms of their flexibility and dispatchability. Particularly, thermocline packed-bed single-tank configuration was shown to be a promising and economically appropriate solution, which utilizes low cost filler materials as TES working media. In this work, some natural and by-product materials, i.e. Basic Oxygen Furnace (BOF)-Slag, Magnetite ore and River rock, were evaluated as filler materials for a pre-industrial 20 MWh_{th} TES system that will be coupled to a 1 MW_{el} commercial pilot CSP plant. Through their structural characterization, thermophysical properties and comparison with already applied materials for this type of configuration the most promising one in terms of its specifications for sensible TES is selected. The most promising material will be validated at a 200 kWh_{th} (1/100 real scale) laboratory scale TES prototype that is being constructed within the framework of the Organic Rankine Cycle (ORC) – Plus project.