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Structural and thermophysical characterization of potential natural rocks for medium temperature thermal energy storage in CSP plants

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ABSTRACT

Natural rocks are a very promising option for medium temperature range (100-300 °C) thermal energy storage (TES) applications as they are low-cost and abundant in nature. For concentrated solar power (CSP) plant working in this temperature range, the state-of the art of TES (Two-tank molten salts system) is not an option as its storage materials has a very high solidification temperature (e.g. 220°C for Solar salt). Dual medium thermocline (DMT) storage system is very suitable for this range of temperature as it incorporates a solid filler material. However, the choice of this latter should be done wisely and based on many technical and economic criteria. In this scope, the aim of the present paper is the conduct a preliminary assessment of the structural and thermophysical properties of four potential natural rocks. These materials were chosen based on previous related experimental investigations and they were identified and collected from a nearby region (Sidi Bou Othmane) of the Green Energy Park in Benguerir (Morocco), which are namely: two varieties of quartzite rocks (PSB1 and PSB2), cipolin (CIP), and grenatite (GAG). The four materials were subject to different laboratory techniques (e.g. SEM, XRD, DSC, etc.), and the obtained results suggests that monophasic quartzite rock (PSB1) and cipolin (CIP) are very suitable for medium temperature rang application. In fact, they have the highest thermal capacity (3098 kJ/m³ °C and 3019 kJ/m³ °C respectively), and they are stable up to 500 °C.

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