**Numerical study on the performance of rocks as thermal energy storage materials in a granular bed**

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**Abstract**

The numerical modeling of thermocline systems, particularly in granular fixed beds, is an important step toward understanding the physical phenomena that can reduce energy losses and improve the performance of a fluid and solid-phase storage system.

The Schumann mathematical model used in this study is a one-dimensional continuous model that generates the temperature profile of natural rock, which is used as a storage medium, and the fluid temperature, which is the air exchanging heat with the solid material. Understanding the heat transfer processes in compact beds of natural rock is crucial for building a more efficient storage system. The primary goal of this work is to investigate how applied pressure, particle size, and fixed radial and axial bed dimensions affect heat transfer by measuring effective thermal conductivity. The results of this storage system's numerical modeling show that the thermophysical properties of the storage material (conductivity, specific heat, particle size) significantly affect the quality of energy stored in the packed bed when a constant air mass flow rate and pressure are used. On the other hand, the influence of the axial bed geometry is negligible, whereas the influence of the radial dimension of the bed is significant.

This modeling provides an opportunity to visualize temperature profiles in the bed of the rocks over time and space in order to evaluate the stored energy that can be recovered later.

**Keywords**: Sensible heat, energy storage, continuous model, rocks, air.