Experimental And Model Investigation Of A Rock-bed Heat Storage System Used For Cooking Applications

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Abstract

In the present study, the thermo-fluid dynamic behavior of an energy storage rock-bed (RB), used to transfer energy for cooking purposes, was analyzed through experiments and numerical models. The objective of the study is to design a system capable of saving waste energy for long periods, with cheap and common materials. Rocks were used as storage medium and air as a heat transport fluid. The system consists of a thermally insulated rock-bed, where waste energy is introduced with electric resistance, a channel without rocks, and a fan. The fan is used to recirculate a flow of air that moves the energy from the RB to the channel where energy extraction takes place with the help of a heat pipe (HP). When the system is not used, the energy losses are limited by turning-off the fan, and the energy extraction by convection heat transfer is increased when the fan is on. Different geometrical configurations of the system were tested to maximize the heat transfer from the rock-bed to the HP. The same rock-bed and fan where used, but the distribution of the rocks and the position and shape of the energy extraction channel were changed. A transient 2D model of the system was developed and tested using COMSOL Multiphysics. The results from the 2D model were compared with the data obtained from the experimental setup. The 2D model shows good agreement with the experimental data.