Modeling and parametric analysis of a building-integrated seasonal thermochemical storage system with Zeolite 13X

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Thermochemical heat storage (TCHS) represents a promising technology that could be applied to store renewable thermal energy with theoretically high round-trip efficiencies over large time intervals. This work focuses on the numerical study of the integration of an open cycle TCHS system based on the adsorption/desorption of H_2O on Zeolite; the storage is installed within a standard domestic heat user. The system operates through two distinct phases. Firstly, the storage is charged (desorption reaction) during the summer season by the exploitation of solar energy gathered through medium-temperature solar collectors. During the winter season, the system can provide heat through the adsorption reaction. To evaluate the performances of this concept, a complete numerical model of a residential thermal user has been developed using TRNSYS18. The TRNSYS18 model includes all the thermal subsystems required to maintain the thermo-hygrometric comfort of the occupants. The thermochemical system operates as a fixed-bed reactor that is operated through sorbent batch replacements. The TCHS reactor is represented through a 1+1D discretized numerical model that has been previously validated exploiting experimental data collected within RSE's laboratories. Finally, a parametric study has been carried out to evaluate the effects of the sizing variables on the main energetic KPIs.

This work has been financed by the Research Fund for the Italian Electrical System under the Three-year Research Plan 2025-2027 (MASE, Decree n.388 of November 6th, 2024), in compliance with the Decree of April 12th, 2024.