EGU25-18279, updated on 20 Apr 2026
https://doi.org/10.5194/egusphere-egu25-18279
EGU General Assembly 2025

Evaluation of Geomaterial Mixtures for Sustainable Energy Storage Solutions especially in Post-Mining Sites

Oskar Snarski, Wiktor Korpak, Konrad Kołodziej, and Marcin Lutyński
Katedra geoinżynierii i eksploatacji surowców, Politechnika śląska, Gliwice, Poland (os310385@student.polsl.pl)

Post-mining sites have become a focus of interest for researchers in terms of their potential use as energy storage sites. One of such ideas is the concept of Adiabatic Compressed Air Energy Storage (CAES) in mine shafts, developed and patented by scientists from Silesian University of Technology. This idea incorporates a suspended TES (Thermal Energy Storage) bed filled with accumulation material. The key element of the system's effectiveness is the selection of the proper accumulation material. This material should have a high ability to accumulate and retain heat, be economical, easily accessible, and have a low environmental footprint.

This research presents the results of analyses of geomaterial mixtures based on wastes from basalt open-pit mines and aggregate processing waste, with the addition of cement binders. In particular, the focus was on the use of basalt dust, which is a by-product of dedusting and basalt processing. The tested mixtures are used to construct a packed bed of granular material.

Thermal properties of the mixtures, such as heat capacity, were analyzed using the Thempos SH-3 sensor from Meter. The heat capacity of the tested mixture was determined to be 1.9 C [MJ/m3×K], compared to the heat capacity of basalt, which ranges from 0.7 to 2.14 C [MJ/m3×K].

Flow analysis demonstrated that a bed with a regular grain shape heats up 12% faster than a bed with irregular grain shapes. The geometry of the granular bed significantly impacted air flow and heat distribution, with regular-shaped beds providing better and more uniform results compared to irregular beds.

The study highlights the potential application of waste-based geomaterial mixtures in thermal energy storage systems, emphasizing their thermal performance and suitability for packed bed construction. These findings contribute to the development of sustainable energy storage solutions leveraging post-mining and industrial by-products.