Comparative Techno-Economic Assessment of Thermal Energy Storage Material Candidates with a focus on SIM type sorbents

Semester project
Spring 2024

Context

Within the European context, the heating and cooling sector stands out as a significant energy consumer, responsible for half of all consumed final energy. Notably, 68% of the European Union's gas imports are dedicated to heating and cooling. Energy in this sector is utilized for various purposes, including space heating, water heating, process heating, cooling, cooking, and space cooling. A crucial imperative for achieving sustainability goals in Europe is the substantial reduction of fossil fuel utilization in heating and cooling applications. However, the integration of renewable energy sources into these systems necessitates innovative and affordable solutions due to their intermittent nature, particularly evident in solar energy. To address this, the development of energy storage technologies is crucial to compensate for temporal discrepancies between energy demand and peaks. To this end, sorbent-based thermal energy storage (STES) materials are often proposed as a possible way to achieve this seasonal storage, with a multitude of storage materials to choose from such as hygroscopic inorganic salts, adsorbent matrices and the more recent Salt-In Matrix type materials which are essentially a combination of the salts and adsorbents while overcoming their individual disadvantages. Therefore, it is critical to understand the economical significance of using a seasonal thermal storage system first, and then understand which material can better store a given amount of energy by estimating the specific cost of storing energy to make an informed decision.

The project / tasks

- Understanding the basics of the sorbent-based thermal energy storage systems

- Detailed literature review to gather data on the chosen TES (Thermal Energy Storage) materials
- Detecting the key processes via the results, and carrying out the sensitivity analyses for different scenarios, such as integration of heat pumps.
- Calculation of specific cost of storage for different storage materials

Skills

- Understanding of the basics of techno-economic assessments
- Results interpretation and report writing
- Having a reasonable command of English

Administrative

This project is part of research work in IPESE at EPFL-Sion. The project will be supervised by Sai Sudharshan Ravi (IPESE). If interested, please send your CV, with short motivation letter, to sai.ravi@epfl.ch.

References

1. Aghemo L, Lavagna L, Chiavazzo E, Pavese M. Comparison of key performance indicators of sorbent materials for thermal energy storage with an economic focus. Energy Storage Materials. 2023 Jan 1;55:130-53.
2. Mohapatra D, Nandanavanam J. Salt in matrix for thermochemical energy storage-A review. Materials Today: Proceedings. 2023 Jan 1;72:27-33.