Experimental Assessment of Calcium L-Lactate as Thermochemical heat Storage Material

Emanuela Mastronardo[1], Emanuele Previti[1], Luigi Calabrese[1], and Candida Milone[1]

[1]University of Messina

March 14, 2024

Abstract

ThermoChemical heat Storage (TCS) technology based on salt hydrates offers a viable path in the transition towards more sustainable energy systems. Albeit, the materials explored so far, within the class of inorganic salts, suffer of severe drawbacks due to the deliquescence phenomenon. We aim at progressing here by proposing an organic salt hydrate, namely calcium L-lactate pentahydrate (CaLP), which is able to combine a low water solubility, that is, more resistance to deliquescence, with the coordination to a high number of water molecules and stability under operating conditions. The thermochemical behaviour for thermochemical energy storage applications of this salt has been experimentally assessed for the first time. It was demonstrated that CaLP reversibly dehydrates/hydrates within an operating temperature range suitable for low-temperature thermochemical heat storage. Additionally, the material showed a good thermal and chemical stability. Morphological and structural investigation conducted in-situ were carried out while dehydrating/hydrating. Furthermore, water vapor pressure (pH2O) and temperature boundaries conditions were identified for defining the operating conditions required by this salt for its future use as thermochemical heat storage material. The heat storage and release capacities were estimated to be 1127-900 kJ kg-1 (or 1696-1355 MJ m-3), thus ranking this organic salt among the most competitive inorganic counterparts. As further advantages, calcium L-lactate is inexpensive, non-toxic, largely available and shows no deliquescence related issues, making it suitable for realistic large-scale apparatus.

Hosted file

`Articolo_CaL TES_Template EEM.docx` available at https://authorea.com/users/755177/articles/725051-experimental-assessment-of-calcium-l-lactate-as-thermochemical-heat-storage-material