Thermochemical heat storage: salts hydrate/biochars composites

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To decrease the dependence on fossil energy sources (expensive, limited and polluting), the solution is to orient the development towards the use of renewable energies. Solar energy is the most abundant renewable energy source. Unfortunately, solar energy is intermittent; consequently, the need to bridge the gap between energy supply and energy demand remains a challenge. For this reason, identifying, developing, and optimizing the energy storage technologies is the entryway to a renewable energy-based economy [1].

Systems based on thermochemical heat storage have the advantage of presenting negligible heat loss during storage and a higher heat density [2]. The solid storage material is at the heart of such thermochemical heat storage systems, and it must possess certain specific properties, such as a high energy density, a high affinity for the sorbate, water (to ensure the exothermic chemical reaction involved in the heat releasing step) without or with controlled deliquescence, a high thermal conductivity, and a resistance to the atmospheric pollutants to ensure the durability and cyclability [3].

Certain properties such as high energy density, low charging temperature with a good mass and heat transfer are used as criteria for choosing the potential candidate. Thanks to the high theoretical energy density, salt hydrated based systems has been attracting growing interests. Though, the performance did not meet expectations due to the kinetic hindrance and formation of aggregates. Dispersing the salt in-side a porous host matrix is the proposed solution to achieve the full potential energy of the salts. An interesting choice of porous support are biochars, activated or not. During the thesis research, biosourced carbons (biochars) will be prepared by pyrolysis and selected as porous support for impregnating various salts. Our main objective is to gain insight on the behavior of the salt during dehydration/hydration cycles once confined inside the biochars pores. The modulation of the biochar's porosity will be realized by post-pyrolysis activation and by the choice of adapted biomass sources possessing an intrinsic meso/macroporosity that will be maintained during the controlled pyrolysis process. The deliquescence phenomenon will be also investigated and mastered by the confinement of the salts into the pores, and by coupling different salts to create bi-salts composites [4].

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