Proceedings of the International Conference on Fluid Flow and Thermal Science (ICFFTS'20)
Virtual Conference – September 9-10, 2020
Paper No. 127
DOI: 10.11159/icffts20.127

Salt Impregnated Matrices for Water-Vapour Adsorption-Based Thermal Energy Storage

Curtis Strong[1], Suboohi Shervani[1], Ye Carrier[1], F. Handan Tezel[1*]
[1]University of Ottawa
161 Louis-Pasteur Private, Ottawa, Canada
cstro043@uottawa.ca; sshervan@uottawa.ca; ye.carrier@uottawa.ca; handan.tezel@uottawa.ca

Extended Abstract

Renewable energy sources have been increasing in both supply and demand in recent years and this trend is expected to continue as countries phase out fossil fuels. Although renewable energy sources such as solar power are more sustainable and produce fewer emissions, their energy output is inconsistent and does not temporally match the consumer energy demand. One solution to this problem is to store energy when it is in excess and release it when it is in greater demand. One promising new method of energy storage is water vapour adsorption-based thermal energy storage, which can compactly store heat for long periods of time with minimal energy losses. However, new adsorbents need to be developed and tested in order to make this technology technically and economically viable.

In the current study, vermiculite was impregnated with lithium chloride and silica gel was impregnated with calcium chloride and lithium chloride, in an attempt to increase the energy storage density of the material. The granular host materials were impregnated with the hygroscopic salts using an incipient wetness impregnation method. The composites were then packed into a lab-scale adsorption column and breakthrough experiments were performed. The temperature and humidity breakthrough curves were analysed and key performance parameters including energy storage density and thermal power were calculated and compared. The stability of the composite materials was assessed by performing multiple adsorption and desorption cycles and observing any changes in performance and/or breakthrough behaviour. The tested composites showed exceptionally high energy storage densities (155-330 kWh/m3) at an inlet relative humidity of 50% after a regeneration temperature of 120°C but showed degradation and limited stability after multiple cycles.