Research Grants for PhD students from the China Scholarship Council

Information Form (please read the guidelines carefully on the website www-csc.utt.fr)

Supervisor's name : KUZNIK Given names : FREDERIC

Status (prof., assistant prof., …) : PROFESSOR

Laboratory :	Center for Energy and Thermal Sciences (CETHIL, UMR 5008)	Website address : https://cethil.insa-lyon.fr/en/
Institution :	National Institute of Applied Sciences Lyon (INSA Lyon)	Website address : https://www.insa-lyon.fr/

Scientific competence of the supervisor:

My domain of expertise is thermal energy storage for a sustainable energy. Concepts of thermal energy storage include sensible heat, phase change, physical sorption and chemical reactions. The mutli-scale approach that I have developed ranges from the molecule scale (molecular dynamics) to the system scale. Research activities include both, numerical modeling and experimental approaches. The objectives of my research are the development, optimization and test of new thermal energy storage systems for the rationalization of energy management, including the use of renewable energy.

Two major publications in the field proposed for the PhD :

1. F. Kuznik, K. Johannes, C. Obrecht, D. David, "A review on recent developments in physisorption thermal energy storage for building applications", Renewable and Sustainable Energy Reviews, vol. 94, pp. 576-586,
2. A. Fopah Lele, F. Kuznik, H.U. Rammelberg, T. Schmidt,W.K.L. Ruck ”Thermal decomposition kinetic of salt hydrates for heat storage systems”, Applied Energy, vol. 154, pp. 447-458, 2015.

Website address of the personal page : https://cethil.insa-lyon.fr/content/kuznik-frederic

Supervisor's email : frederic.kuznik@insa-lyon.fr

Description of the research work proposed for a PhD ***Topic # (see list) :*** V-4

Title : Thermochamical heat storage in buildings: mutli-scale numerical modeling and optimization

Subject :

E.U. has identified heat storage in buildings as a key technology for energy and CO2 emissions reduction. Heat storage allows to increase the use of solar energy and to rationalize the grid energy management. Moreover, it can also be a sustainable way to produce cold during summer. Among the existing technologies, the use of chemical reactions is really promising because of its high energy density. In my laboratory, we have identified and characterize 3 solid salts that can react with water vapor to store heat. However, a lot of issues remain when considering the integration of those salts into heat storage reactors. Based on our expertise on system development, the first objective of the thesis is to develop a numerical model of the heat storage by modeling heat and mass transfers as well as reaction thermodynamics and kinetics. Then, in a second step, the system will be optimized by implementing genetic algorithm to the previously developed model. The third step will be the construction and test of the optimized heat storage reactor in our existing experimental platform (the experimental results will allow to validate the numerical models). I parallel, a simplified model of the system will be designed using, for instance, neural network approach. Finally, the simplified model will be integrated into our MODELICA platform in order to numerically assess the performances of the system integrated in a building.

Keywords :

heat storage, energy management, numerical modeling, experimental test, opimization

Expected collaborations :

I'm participating to workgroups of the International Energy Agency dealing with thermal energy storage (https://iea-eces.org/annexes/#running-energy-storage-in-energy-systems). Then, the PhD student will have to participate to the meetings and present his work. I also consider a possible collaboration with TU Eindhoven, Netherlands.

Background required from the applicant :

The applicant must be comfortable with numerical modeling with a strong background in heat and mass transfer. The applicant has to be curious with capacities to present his work to other researchers. A good level in English is required.

Existence of a PDF file detailing the proposal ("yes" or "no") : no

(see guidelines on the website www-csc.utt.fr)