PROPOSITION DE THESE 2019

>Réf: Avant-projet de thèse N°ED/02/2019

Project title	**Modelling and simulation of a solar dryer with integrated thermal storage based on sorption materials**
Keywords	solar drying, dried mango, thermal storage, sorption storage
Background	Exports from dried mangoes exporting countries in West Africa (Côte d'Ivoire, Mali, Senegal, Burkina Faso) account for about 10% of the European market with recognized product quality. The dried mango sector generates € 46 million annually in Burkina Faso, corresponding to a contribution of 0.5% to the country's GDP. The drying capacity of a few tens of kilograms of fresh mangoes per day by the solar drying units against about a ton of fresh mangoes per day for natural convection gas-fired dryers and especially the drying time (3 days with a solar dryer as opposed to 8 h with gas-fired dryers) leads to a situation where professionals in the dried mango sector use practically no longer solar dryers but gas-fired dryers. Now, natural gas represents about 15 to 30% of the production cost. According to operators in Burkina Faso, if natural gas were not subsidized, the activity would not be profitable. The situation could therefore change if the subsidy is removed; this would not be surprising or is even likely to happen in the light of current public policies, which are more focused on sustainable development. Knowing that the production of 1 kg of dried mango requires on average 0.8 kg of natural gas and that the country has exported in 2016 about 1900 t of dried mangoes, it could easily be understood that there is a challenge of a solar solution for this booming sector. The drying of mango is spread over a period from April to September, corresponding roughly to the rainy season, which is already challenging for solar drying. These aspects affect the relevance of the solar dryers for mango drying in this context. As solution, a sorption material can be added to the conventional dryer to enhance dehydration in the daytime and allow drying in the night-time through a thermal storage.
Objectives	The general objective of this work is the development of improved solar dryers by incorporating adsorption materials that will promote drying and allow continuing drying even at night with thermal storage. In this way, the drying duration may be significantly reduced. In order to avoid investing in a costly development of several prototypes, it is planned, at the first stage, to limit the investigation to the theoretical analysis of the performances of the proposed solar dryer. This requires the development of two models to be coupled: a model of solar dryer and a model of a sorption bed. Some preliminary works have been already done on the modelling of the solar dryer i.e. without a sorption bed.

	To achieve this objective, the following activities need to be undertaken: ▪ Consolidate the available model of solar dryer and validate it against available data in the literature ▪ Implement a model of an adsorbent bed, using a model already validated in the literature ▪ Develop the model of the proposed solar dryer ▪ Simulate the performance of the proposed solar dryer; a year-round simulation will be performed using weather data corresponding to the tropical wet and dry climate in West Africa (typically Bobo-Dioulasso, Burkina Faso) ▪ Propose a design of a prototype of the solar dryer, based on simulation results and exchanges with stakeholders ▪ Predict the system performance over one year ▪ Perform an economic analysis of the concept ▪ Build a demonstration prototype if the concept proves relevant
Expected results	▪ A model of a solar dryer with integrated thermal storage based on sorption (Sothes) materials is established ▪ The technical and economic performances of such a Sothes are determined ▪ The relevance of a solar dryer with integrated thermal storage based on sorption materials is evaluated ▪ A design of prototype of Sothes is proposed ▪ (A prototype of Sothes is built and tested)
Host laboratory	Laboratoire Énergies Renouvelables et Efficacité Énergétique (LabEREE), 2iE
Thesis supervision	Prof. Igor OUEDRAOGO, 2iE, Burkina Faso Prof. Frédéric KUZNIK, INSA de Lyon, France Dr.-Ing. habil. K. Edem N'TSOUKPOE (HDR), 2iE, Burkina Faso Dr. Babacar LEYE, 2iE, Burkina Faso
Starting date	September, 1st, 2019
Duration	3 years
Candidate profile	▪ Master degree in an appropriate field (energy engineering, mechanical engineering, etc.) ▪ Good knowledge of at least one coding software such as Matlab ▪ Ability to work independently and good and interpersonal skills ▪ English language required, French would be a plus
To apply	The completed application file must include: ▪ A cover letter ▪ A CV ▪ A copy of your Master's diploma or equivalent ▪ Copies of your academic transcripts (master level or equivalent) ▪ Your master thesis (dissertation) Please, be careful to indicate clearly the reference and the topic of the thesis at the application stage. **The complete application file must be sent by 05 May 2019** at the latest to: Arianne Mélodie OUEDRAOGO Institut 2iE, 01 B.P. 594 OUAGADOUGOU 01 Burkina Faso Email : ariane.ouedraogo@2ie-edu.org