

Polytech network form for PhD Research Grants from the China Scholarship Council

This document describes the PhD subject and supervisor proposed by the French Polytech network of 14 university engineering schools. Please contact the PhD supervisor by email or Skype for further information regarding your application.

Supervisor information	
Family name	Amiri
First name	Ouali
Email	Ouali.amiri@univ-nantes.fr : skype :amiriouali
Web reference	http://www.univ-nantes.fr/site-de-l-universite-de-nantes/ouali-amiri--904959.kjsp
Lab name	GeM, UMR 6183
Lab web site	https://gem.ec-nantes.fr/
Polytech name	Nantes
University name	Nantes
Country	France

PhD information	
Title	Experimental and numerical investigation of the hygrothermal behavior of eco-materials : consideration of climat change effect on their durability
Main topics regards to CSC	

list (3 topics at maximum)	IV-7 Materials for environment and ecology IV-10- Bio-matériaux et matériaux polymères V-11- Change of world climate and climatic forecasting
Required skills in science and engineering	Tranfert in porous media, building materials, numerical methods and computing.

Subject description (two pages maximum)

In recent years, there is a great interest in the scientific research in general and civil engineering in particular in environmental issues. As the construction industry is constantly growing, the ecological impact is very important and the change in our habits becomes more essential and urgent than ever. Possible promising solutions developed in recent years include Eco-construction : materials with low cement dosage. The challenge is to find future building solutions for a sustainable environment. Its objectives include:

- achieve high environmental performance and energy efficiency.
- ensure the health and well-being (comfort) of its occupants.
- give priority to environmental quality materials focusing on their environmental and health awareness.

The proposed PhD will be focused on the eco-construction and more specifically on heat and mass transport on eco-materials with low environmental impact (eco and bio building materials or nano-particules i.e manufactured with weak cement ratio) and on the study of their environmental behavior and failure (mechanical, moisture resistance...). In addition to bio building materials, it will be focused on cement based materials containing nanomaterials such fly ashes and slag obtained by macanosynthesis and modified by PCA (Process Control agents).

The study will be approached on different scales:

- at the material scale to identify and characterize the properties of these eco-materials (physical and mechanical) including the moisture transport and storage properties in order to optimize their formulation for better durability.

- at the wall scale to assess the behavior of these materials in interaction with their real and aggressive environment. Furthermore, it will be interesting, in this scale, to consider the properties spatial variability impact of these new materials on their hygrothermal behavior and durability.

This topic is going to deal with both modelling and experimentation aspects:

- In terms of modeling, the aim will be to improve the existing analytical models of coupled heat and moisture transfer by integrating the uncertain and heterogeneous (probabilistic) aspects of certain transport parameters. The study will focus also on the effect of climate change on the heat and mass transport evolution through the considered eco-materials. A first study is already in our laboratory to study the effect of climate change on chloride ingress in concrete.
- In terms of experimentation, it will first be required to characterize Eco-materials on a reduced scale to determine deterministic model parameters (water vapor permeability, air permeability, sorption isotherm, thermal conductivity, heat capacity...). Then, an experimental investigation on walls (scale 1) will be carried out based on the bi-climatic room available in GeM laboratory at university of Nantes. These experimental studies will be used to validate the developed models and to propose construction methods and technical answers regarding the use of the studied eco-materials.

References:

- [1] AV. Luikov, Heat and mass transfer in capillary-porous bodies, 1st ed. Oxford: Pergamon press; 1966.
- [2] N. Issaadi, A. A. Hamami, R. Belarbi, A. Aït-Mokhtar, Experimental assessment of the spatial variability of porosity, permeability and sorption isotherms in an ordinary building concrete, Heat and Mass transfer. October 2017, Volume 53, [Issue 10](#), pp 3037–3048.
- [3] Phu Tho Nguyen, Emilio Bastidas-Arteaga, Ouali Amiri, Charbel-Pierre El Soueidy. An efficient chloride ingress model for long-term lifetime assessment of reinforced concrete structures under realistic climate and exposure conditions. *International Journal of Concrete Structures and Materials*, Springer, 2017, 11 (2), pp.199-213.