Application for recruiting Post Doc researcher

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Short description of research field

While the demand for greener and smarter built environment is increasing globally, new materials and technologies are needed to achieve this goal. Cementitious composites are the world's most consumed man-made material and play a key role in the green and smart shift in the infrastructure. Modification, characterization, modelling and recycling of cementitious composites to improve sustainability, increase energy efficiency, enable multifunctionality as well as imposing digitalization and smartness to such composites is in the scope of research activities in the Sustainable Composites research group. This individual fellowship will be integrated into Dr. Mohammad H. Baghban. Researchers who join us will cooperate in a diverse group of experts who work on different aspects material and manufacturing technology as well as sustainability assessment and digitalization. Exploitation of natural and bio-based materials (e.g. natural fibers, natural binders, bio waste, etc.), nano-materials (e.g. graphene, Carbon nanotubes, nanosilica, aerogels, etc.) in cementitious materials as well as taking the advantage of key material properties (thermal, mechanical, electrical), pore structure and moisture behaviour are some of the approaches in this research field. Furthermore, material characterization and model development for design, simulation or even additive manufacturing of modified, recycled or new materials, which is also a part of activities in this research group.
Advanced bio-based cementitious composites

1. Introduction

Cementitious composites as the world's most consumed man-made material and play a key role in the green and smart shift in the infrastructure. While Portland cement has the main responsibility for CO2 emission of concrete, replacing it by other cementitious materials or additives, is one of the most effective methods in reducing greenhouse gas production. Substitution of every kilogram of cement by cementitious material reduces CO2 emission by up to one kilogram. Using fine siliceous materials such as fly ash, ground granulated blast furnace slag, silica fume, which react with calcium hydroxide at room temperature during hydration has been on the focus in previous years. Clay as the natural source of silica and alumina can form an alternative binder for cement in presence of lime and calcium sulphate. Adding natural fibres obtained from materials such as hemp and straw can reinforce the composite without increasing emissions. Furthermore, bio char obtained from gasification process has the potential to be considered as zero-emission material used as a part of binder. Replacing all or some part of the aggregates with agricultural wastes such as wood wastes can also increase the role of biomaterials in cementitious composites. The focus of this research project is the development, optimization, and characterization of cementitious composites containing biomaterials in forms of binders, fibres and aggregates.

2. Objectives

The main objective of this project is development, optimization and characterization of cementitious composites containing biomaterials. The project has the following sub-objectives:

1) A state of the art description of how different biomaterials may affect properties of cementitious composite materials.
2) Experimental investigation of selected materials and processes to achieve intended material properties.
3) Characterization of the material properties and environmental impact assessment of the selected materials.
4) Documentation of the production or treatment processes for the investigated materials in forms of patent applications, scientific papers and project report.
5) Lay the basis to further research projects, which aims for innovative solutions for sustainable building and construction sector including RCN and EU projects.

3. Research questions

The project will answer following main research questions corresponding to the project objectives:

1) What are the key factors affecting intended properties of cementitious composites containing biomaterials?
2) What are the most promising materials, processes, and applications of sustainable cementitious composites containing biomaterials in terms of cost, efficiency and environmental impacts?