Name: **Amaia MATANZA CORRO**

Email: a.matanza-corro@univ-pau.fr

Supervisors: Céline Perlot, Silvina Cerveny (CSIC-UPV/EHU)

Partners/Funding: Co-mentoring University of the Basque Country
Eurorégion Nouvelle Aquitaine-Euskadi-Navarre

Status: PhD started on the 10/2017, ATER

Nanomaterials reinforced concrete for improved durability infrastructures under marine environments

Abstract:

Addition of nanomaterials in concrete could enhance properties at hardened state and durability performances. The effect of nanomaterials starts by the modification of cement hydration reaction. Therefore, purpose of this study was to understand the modifications on the properties at fresh state and cement hardening by the addition of different nature and type of nanomaterials and try to relate with the durability performance at hardened state. Cement hardening was examined trough setting time and rheology within mini-slump tests. Correlation was made between results and mechanical performances at early age, measured by compressive and flexural strength. A blended cement with fly ash and slag was mixed with three different kind of nanomaterials: graphene oxide nanoplatelets (GO) nanocellulose in microfibrils form (MFC) and nanosilice (NS). Due to the different chemical composition and morphology, these nanomaterials affect in a very different way to the cement hydration reaction. GO act as nucleation nodes for hydration products. MFC, due to its hydrophilic properties, the retention of mixing water significantly decreased workability. NS increased the reactivity of cement hydration acting as nucleation nodes and promoting supplementary cement hydrates (pozzolanic reactions).

Results and Discussion:

The study of the fresh state properties of cement pastes and mortars containing nanomaterials allowed us to draw the following conclusions: Nanoadditions modified the hydration kinetics and at scale of mortar behaviour it could be observed also on the workability.

GO influence on the hydration reaction of cement was observed by the reduction of the setting time, an acceleration shown in isothermal calorimetry and an increasing reduction of the workability with the rise of GO dosage. MFC had a big impact on the workability of the paste samples due to their interaction with mixing water, which could be observed on the reduction of spread diameters in slump test. The effect of MFC on mechanical properties depended on the dosage. At higher dosages, the compressive strength increased and the effect was more important at 7 days than at 1 day, which means that there was further hydration reaction with the water kept on the MFC. The absorption of water around its surroundings enhanced hydration and consequently reduced the setting. NS, due to the large specific surface, it is highly reactive and promoted and accelerated the hydration reaction of cement grains. This was shown in isothermal calorimetry and setting time experiments. Normally, initial and final setting times occurred earlier than in reference sample.

Nanoadditions played the role of a bridge with C-S-H microstructure to increase the coherence through covalent bonding and consequently increase mechanical properties at the correct dosage. Compressive and flexural strength tests validated that.