Université Gustave Eiffel

LABORATOIRE CPDM
COMPORTEMENT
PHYSICO-CHIMIQUE ET
DURABILITÉ DES MATÉRIAUX

Postdoctoral offer – Ground granulated blast furnace slag (GGBFS): use of novel raw materials / reactivity testing as supplement cementitious materials

Starting date: April 1st 2024

Contract: 15 months, Université Gustave Eiffel, 2610€ monthly gross wage

Localisation: Champs sur Marne (77), France, in CPDM Laboratory (Physico-Chemical Behaviour and Material Durability), in MAST Division (Materials and Structures) of Université Gustave Eiffel

Research field: Physico-chemistry of materials

Research subject:

With the goal to decrease carbon emissions by at least 55% by 2030 and being the first climate neutral continent by 2050, EU set out in the European Green Deal policy. For these goals to be reached, the EU's industry, including the cement sector, need to transform its current highly CO_2-intensive processes. Decarbonation of the industry brings a lot of uncertainty concerning the future availability of raw materials, especially slag. Indeed, slag, as a co-product of the steel industry, is one of the most vulnerable materials with regard to decarbonation and transition from blast furnaces to electric arc furnaces leading to a decrease in slag quantities (with compositions as we know now) (Kocaba 2009, Kriskova, Pontikes et al. 2013). With the decrease of available quantities, prices are expected to be increased by more than 70% and even beyond and with possibly an increase of CO_2 emissions due to transport (Australia, Brazil and China as the three main steel producers). Because of their performances and characteristics, slag and cements with high slag substitution (CEM III/C) or alkali activated cement (AAC) will still be used for special applications such as when sulphate resistance, low hydration heat, fluidity or good mechanical properties are needed, or for nuclear waste conditioning (Abdel Rahman, Rakhimov et al. 2015, Andra 2023). With similar cement hydrates and redox properties, AAC can be interesting for difficult wastes to immobilized through sorption, incorporation or substitution of elements with radionuclides (Mohamed 2019, Bourchy, Saslow et al. 2022, Mukiza, Phung et al. 2023). Moreover, due to these similarities, required demonstrations for acceptation as conditioning matrix could be simplified.

This study aims to investigate novel materials issued form plentiful long time available raw materials by using an aluminum silicate source, with an important consideration of raw materials sourced from local producers, providing guarantees of plentiful, homogenous long-term deposits. Low carbon bearing sources will equally be privileged whenever it is possible.

The methodology used will begin by a literature review of available raw materials and their composition compared, from which a short list of candidates will be made - different raw materials sources (reactivity, purity) with different proportions of the constituents and the comparison of their properties with alkali activated slag (AAS) cements. From this, several formulations will be developed considering a possible range of variation around targeted properties such as set time (between 3h and 24h), hydration heat or compressive strength (minimum of 8 MPa at 28 days). The evolution of mineralogy depending on the raw materials and their activation, will be monitored with time.

Who are we?

CPDM laboratory (Physico-Chemical Behaviour and Durability of Materials) in MAST department (Materials and Structures) of the Université Gustave Eiffel at Marne-la-Vallée (France), conducts research projects and judicial assessments on different materials used in civil engineering (cementitious and alternative materials, bio-based materials and polymers). Specifically on cementitious materials, CPDM laboratory has several experts working on formulations and their impact on hydration, mineral, chemical and physical characterisation, material implementation, initial to long term performances comprehension and durability testing against internal and/or external attacks.

Candidate profile:

The postdoctoral candidate should have a PhD diploma in material sciences or civil engineering, with an important knowledge in cementitious materials, formulation and characterisation with regards to its physico-chemical behaviour (mineral analysis; reaction kinetic analysis; or mechanical and durability analysis). The candidate should be quickly an independent and ingenious worker after a training period, like to work as a team and be able to publish the results in a scientific journal. The use of regular office software and being fluent in English (oral and writing) are a necessity.

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Key words:

Raw materials, slag, formulation, alkali-activated cement

References:

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