

Master 2 Internship offer – Development of low carbon material from metakaolin activated with alkali and lime

Starting date: February 1st 2026 for 5 to 6 months

Contract: 5 to 6 months internship offer, Université Gustave Eiffel, 567€ monthly gross wage + half the price of public transport subscription

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

Internship subject

Cements with high slag content (CEM III/C) or alkali activated slag cements (AAS) are used for special applications such as when sulphate resistance, low hydration heat, fluidity or good mechanical properties are needed, or for nuclear waste conditioning. However, with the goal to decrease carbon emissions by at least 55% by 2030 and EU being the first climate neutral continent by 2050, slag availability and characteristics become uncertain due to the transition from blast furnaces to electric arc furnaces.

With similar cement hydrates and redox properties, alkali activated metakaolin cement (AAMK) can be interesting for difficult wastes to immobilized through sorption, incorporation or substitution of elements with radionuclides. Moreover, due to similarities with current conditioning matrices, required demonstrations for acceptance as conditioning matrix could be simplified.

Considering this, the aim of this study is to develop low carbon materials by testing various metakaolins and calcium sources combined with alkali activator. Formulations will be developed considering a possible range of variation around targeted properties such as set time, exothermy or compressive strength. The hydration kinetics and the mineral evolution depending on the raw materials and their activation, will be monitored with time. To do so, chemical (ICP), mineral (XRD, TGA) and physical (isothermal calorimetry, Vicat set time) characterisations will be carried out.

PhD on a follow-up subject will be available in the laboratory after the master internship.

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.

Orano Group, is a leading international player in the nuclear industry. Every day, we are committed to producing efficient low-carbon energy to fight climate change, to finding solutions that conserve natural resources, and to

contributing to progress in the field of health. Our strengths? Across the entire nuclear fuel cycle: extensive expertise in cutting-edge technologies, safe and high value-added products and services, specialized know-how, and a strong capacity for innovation. All of which highlight the remarkable skills of our 17,500 employees, whose development we continuously strive to support. In collaboration with Orano's Strategic Decommissioning and Waste Management Division, we are responsible for developing, optimizing, and overseeing innovative methods and materials used to ensure the safe storage of radioactive waste.

Candidate profile

The internship candidate should be in engineering or research master study, specialised in mineral materials and physico-chemical characterisation or civil engineering, with a preference for cementitious materials. Knowledge in formulation and characterisation (mineral analysis and reaction kinetic analysis) and English skills would be highly appreciated. The use of regular office software is a necessity. The internship candidate should be attracted by experimental and team work.

Contact

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Key words

Cement, formulation, metakaolin, alkali and lime activation, mineral characterisation