



Réhabilitation des sols pollués par des oxyanions, étude de sensibilité aux scénarios et réglementations environnementales de gestion des déchets

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Description du projet de thèse :

La réhabilitation et décontamination des sols est une exigence croissante en termes de santé publique et de protection des ressources environnementales. LafargeHolcim (LH) développe dans ce contexte des solutions performantes de solidification/stabilisation par des liants hydrauliques. La rétention des oxyanions (Cr, Mo, Sb, Se) nécessite cependant une optimisation et une compréhension plus fine des processus en jeu suite à leur forte sensibilité à la carbonatation et transitoire redox. Cette optimisation est également pilotée par les tests et réglementations environnementales qui varient selon les pays. Les objectifs de la thèse sont de caractériser et améliorer les effets du traitement stabilisant des oxyanions vis-à-vis des essais réglementaires européens et nord-américains en conditions environnementales de stockage ou de valorisation matière. Le doctorant collaborera avec le centre de recherche de LH (analyses et procédés), le centre de Géosciences de MINES-ParisTech (modélisation géochimique et multiphasique) et l'université Vanderbilt (ingénierie environnementale).

Remediation of soil polluted with oxyanions, sensitivity to exposure scenarios and waste management regulations

Soil remediation and decontamination is a growing demand and comes with high stakes in terms of public health and environmental protection. Landfill of excavated soil from civil engineering construction, contaminated with sulfate and or heavy metals, obeys to strict regulation. The more the soil is considered dangerous, the more the regulations for landfill or valorization are stringent thus making the management of such waste costly. The Solidification / Stabilization (S/S) of the contaminants with hydraulic binders is an interesting path of valorization, for economic and environmental considerations.

Since many years, LafargeHolcim (LH) develops solutions for soil remediation. Efficient binders have already been patented for Sulfates, Pb, Zn..., and for more complex cases such as oxyanions that are commonly observed in industrial polluted sites (Cr, Mo, Sb, Se). However, for oxyanions some optimization is still needed to cope with redox conditions. All the more, environmental regulations vary from one country to another, and especially the way to assess the durability of these treated material. A better understanding of the sensitivity of these material to exposure conditions (acidic, carbonation, redox,) is necessary, to optimize the S/S recipe in order to fulfill local environmental regulation. The Geosciences Dpt. of MINES ParisTech (French high education institution in engineering) has acquired an international recognition in the development of multiphase reactive transport modeling (HYTEC code) and application to hazardous and radioactive waste management, environmental impact, water resource decontamination, geomaterial durability...

Objectives of the Ph.D:

- *Part 1) Review and optimization of existing S/S mix design for oxyanions;*
- *Part 2) Parameter sensitivity vs. granularity, hydric context pH, redox transient stage, carbonation;*
- *Part 3) Optimization of S/S process vs. a) the leaching procedures used in local regulations (Europe, North America, ...), b) the exposure scenarios (landfill, re-use).*

The S/S soil optimization, leaching experiments, possibly including a small-scale pilot, and aqueous/solid phase characterizations will be performed in the LH Research Center. The modeling of the leaching tests and long-term exposure scenarios will be developed at MINES ParisTech. Collaboration with the US Vanderbilt School of Engineering (Environmental Laboratory, Pr. D. Kosson) is part of the PhD project with a scientific stay of several months.

Compétences et connaissances requises / Prerequisite skills and knowledge :

Master's degree in Civil or Environmental Engineering, in Chemistry or Material Sciences and Engineering, possibly in Geochemistry.

Fluent in English (good knowledge in French would be a plus), strong ability for independent work and original thought in a team working network, clear interest in industrial and applied researches.