

13. Evaluation of pollutant transfer from a BOF steel slag used in road construction

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Abstract:

The use of alternative materials in civil engineering, especially in road construction, is developing in order to save natural resources and to promote the re-use of wastes or industrial by-products according to sustainable development strategies. Steel production generates great amounts of by-products as steel slag (about 2.2 million tons in France in 2006). Unlike blast furnace slag which has been extensively used in cement industry, building trade and road construction, the use of Basic Oxygen Furnace slag (BOF slag) has been restrained due to insufficient volume stability and to the lack of environmental regulations. This study aimed at investigating the potential release of pollutants from a BOF slag used in a civil engineering structure (an industrial platform) and their transfer through the underlying soil, using a multi-scale approach. The BOF slag was characterized by a very alkaline pH due to the presence of free-lime (up to 6% of CaO+Ca(OH)₂) and rather high concentrations of chromium, vanadium and barium (respectively 910, 740 and 128 mgkg⁻¹). An experimental platform has been constructed using a 0-6 mm BOF slag and percolating waters have been sampled and analyzed for one year. Total chemical analysis, mineralogical analysis and batch tests according to NF EN 12457-2 standard method have been carried out in order to characterize the slag and to study the release of pollutants. Pollutant transfer through the soil has been studied using laboratory column experiments. Two different soils have been investigated: a sandy soil and a silty clay loam. The inlet solution was obtained from batch tests performed on the BOF slag used for the construction of the platform.

The results of the follow up of the experimental platform showed that the pH of seepage waters was very alkaline, more than 12, and the conductivity was rather high, between 5330 and 9540 μScm^{-1} . Except for Ba (between 1.3 and 2.25 mg L⁻¹), the concentrations of trace elements were rather low, less than 20 μgL^{-1} for Cr and less than 30 μgL^{-1} for V. As regards batch tests, the conductivity of leachates was high, about 8000 μScm^{-1} , and the pH value was more than 12. In the conditions of the leaching test, the release of trace elements was generally low, concentrations of Cr and V were less than 10 μgL^{-1} . The first results obtained from column experiments seemed to indicate a good retention of vanadium by the soil, and chromium appeared more mobile. An attempt of modeling will be carried out with the CHESS model for the speciation of pollutants and with HYDRUS and PHREEQC codes for the transfer processes.

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