Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.17076

Environmental impact of sulfidic mine waste and valorization potential in building materials

PROF. VALERIE CAPPUYNS AND JILLIAN HELSER

KU Leuven

Presenting Author: valerie.cappuyns@kuleuven.be

Proper management and storage of mine waste, e.g., tailings and waste rock, is one of the main issues that mining industries face today. Besides active mining sites, there are many historical mining deposits, which may, even centuries later, pose environmental and human health risks, especially when it contains high levels of mobile metal(loid)s. Valorization of the waste offers a solution to minimize the risks associated with the mine waste, while offering potential economic benefits. After recovering valuable metals and removing hazardous contaminants, the remaining residue can be valorized into green construction materials, such as inorganic polymers, ceramics or cement.

Based on three cases studies of sulfidic mines in Europe, the solid-phase speciation of hazardous elements, in relation to the leaching of elements under different conditions, was first investigated in the mine waste itself, and then in the building products (ceramics, alkali-activated materials and cements) in which the mine waste was incorporated. The acid generation potential and consequent metal(loid) release from mine waste was first determined through geochemical, microbial, and mineralogical characterizations to understand the underlying drivers for acid production and metal(loid) release. Bioaccessibility tests, long-term kinetic leaching tests and thermodynamic modeling were also applied. The results were used to evaluate the environmental and health risks posed by the sulfidic mine waste and the downstream products (valorization of the waste).

The studied mine wastes showed a high mobility and bioaccessibility of Zn, Cd, Cu and As and high acid generation potentials. However, low levels of Pb were released, due to complexation with Fe hydroxides and the precipitation of secondary minerals such as beudantite. The high mobility of some elements also provides opportunities for the recovery of metals and valorization of the residues after metal recovery. Some construction materials were more efficient than others in immobilizing metal(loid)s that could not be recovered or cleaned by flotation and/or bioleaching. Cements/clinkers most effectively immobilized metal(loid)s, due to physical and/or chemical encapsulation, likely from the formation of ettringite.