European Training Network for the Remediation and Reprocessing of Sulfidic Mining Waste Sites

Environmental impact of (cleaned) sulfidic mine waste integrated into construction materials

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Introduction

Sulfidic mine waste can pose **environmental** and **health risks** due to the **acid generation** and subsequent release of **hazardous metal(loid)s**. **Proper management** and **storage** of mine waste is one of the **main issues** faced by mining industries. Additionally, historical mining deposits may still **leach contaminants** into the environment even centuries later.

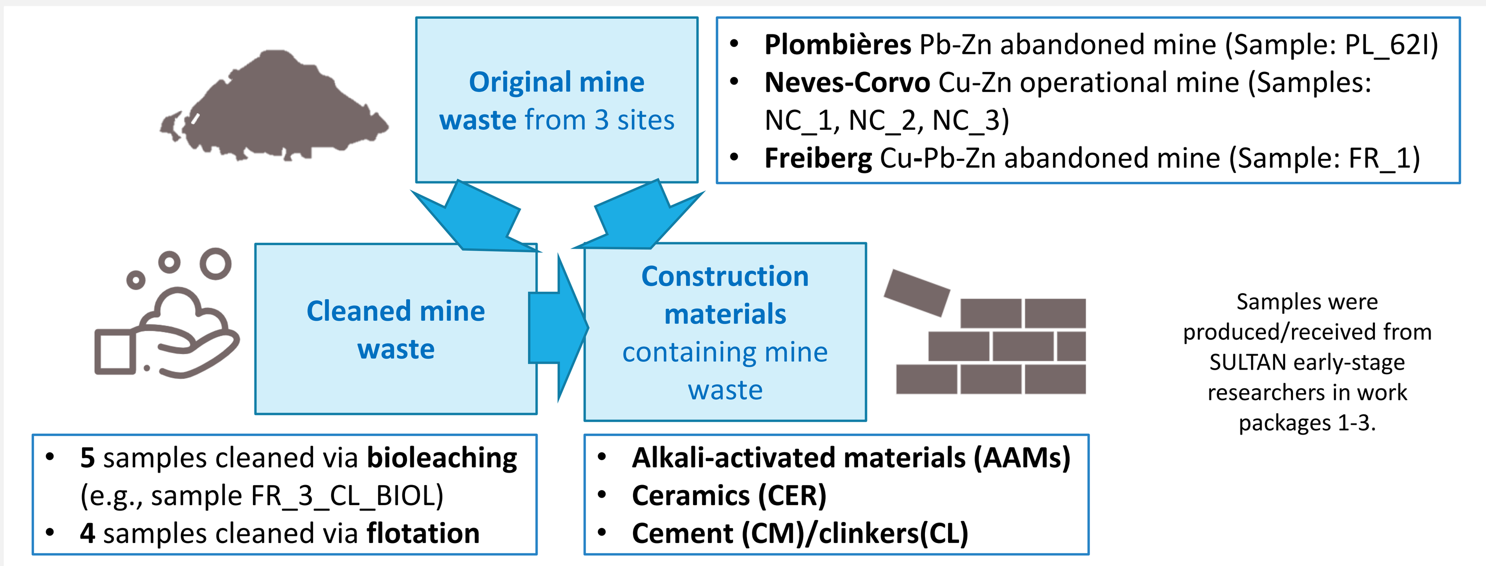
Solution: Valorization of the mine waste by recovering valuable metals and/or utilizing the residue/original mine waste in construction materials.

Objective: Evaluate the mobility of hazardous metal(loid)s from the cleaned mine waste and construction materials containing (cleaned) mine waste in comparison with the original mine waste.

Overall, to assess the changes in **environmental risks** through the **valorization** routes.

Methodology

Samples



Methods

- **Leaching tests:** EN 12457-2 leaching test, Toxicity Characteristic Leaching Procedure (TCLP) and pH-dependent leaching test
- **(Pseudo)total elemental content:** aqua regia digestion
- **Mineralogical characterization**: XRD

Results

EN 12457-2 leaching test with water (L/S ratio: 10 l/kg)

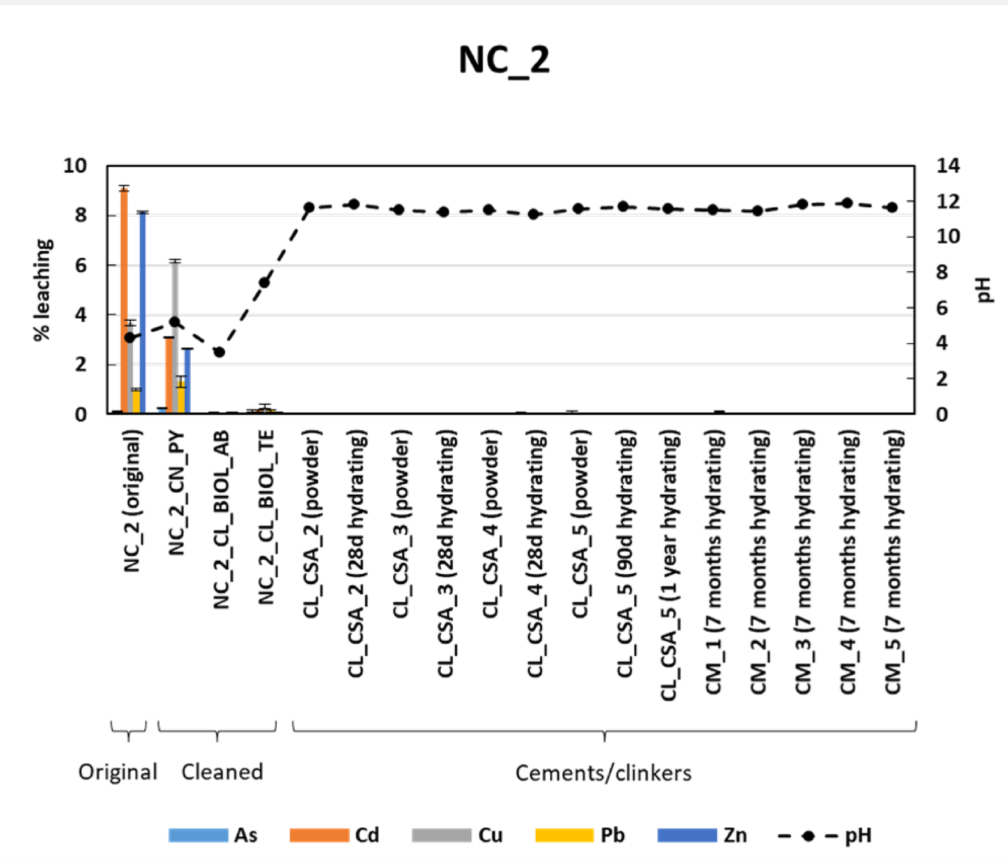


Figure 1 EN 12457-2 test results of the original tailings sample NC_2, cleaned NC_2 samples and construction materials containing NC_2.

Results in Figure 1-2 are presented as a percentage of NC_2/FR_1/FR_3_CL_BIOL in the construction material (%, n=2). The percentage is relative to the pseudo-total metal(loid) concentrations of NC_2/FR_1/FR_3_CL_BIOL determined via aqua regia digestion.

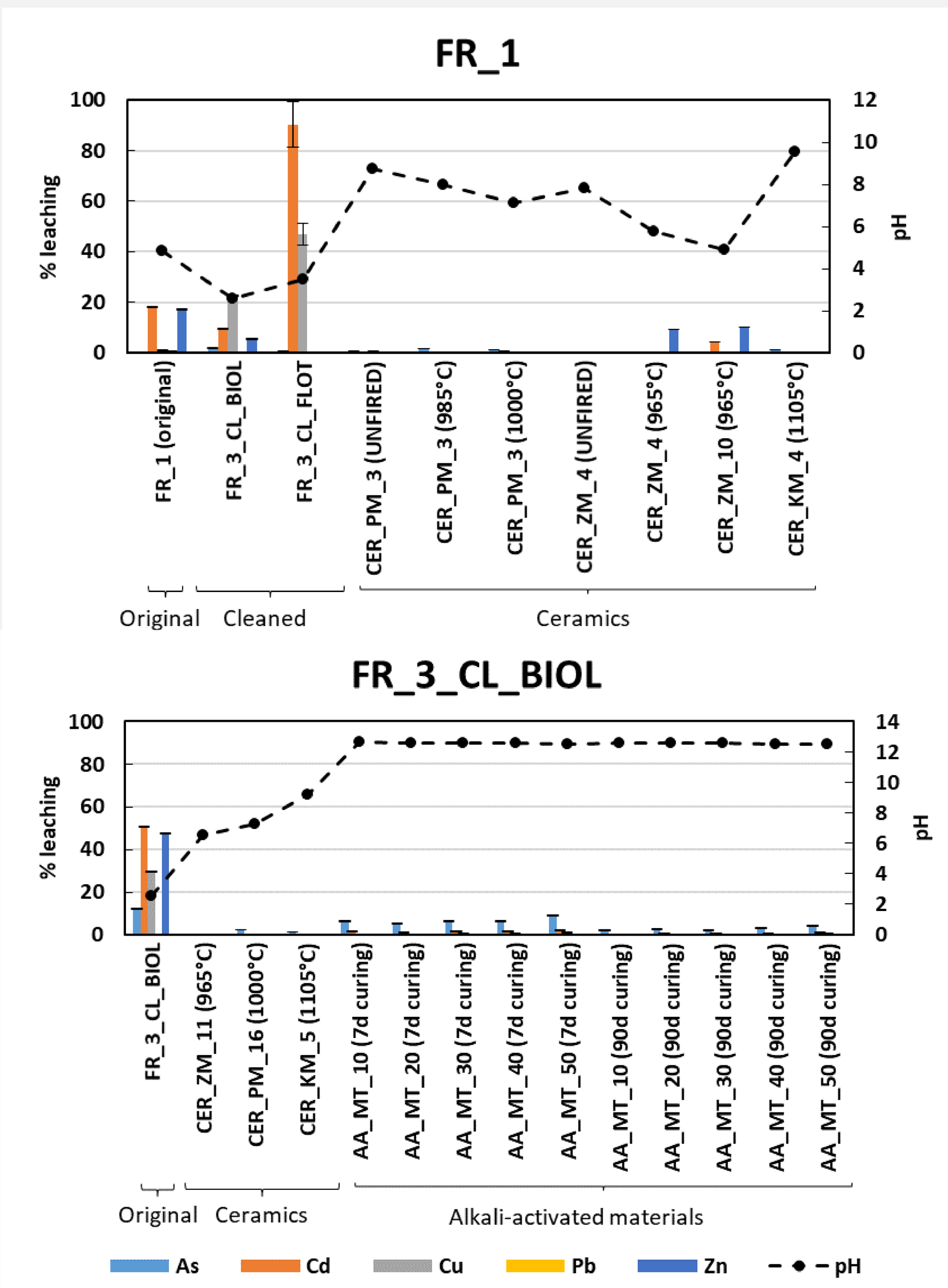


Figure 2 EN12457-2 test results of the original tailings sample FR_1, cleaned FR_3 samples and construction materials containing FR_1 (top). The results for the building materials containing FR_3 cleaned via bioleaching (FR_3_CL_BIOL) are also shown (bottom).

pH-dependent leaching test (L/S ratio: 10 l/kg) and TCLP (L/S ratio: 20 l/kg)

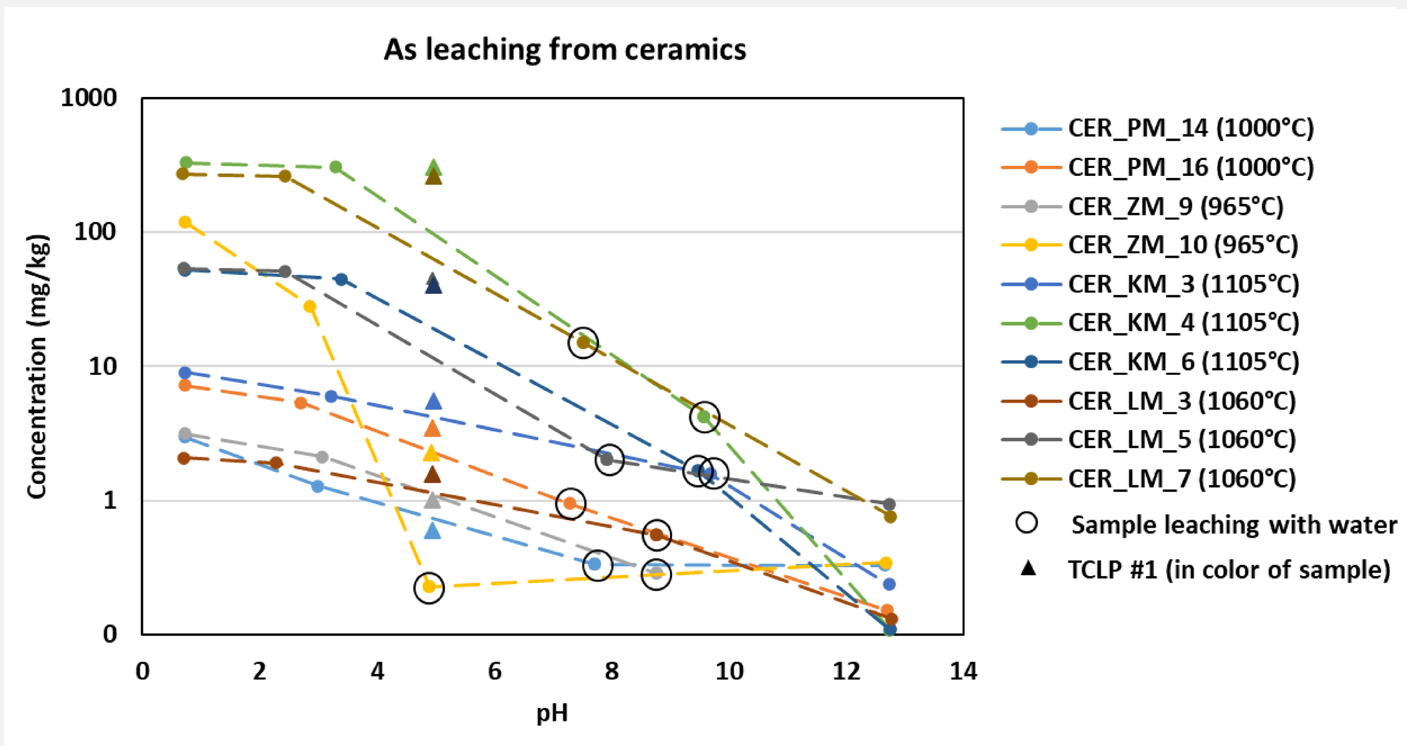


Figure 3 pH-dependent leaching of As (n=2; in mg/kg) from ceramics. The pH-dependent leaching test is connected by a dashed line. The TCLP with extraction fluid #1 (pH 4.98) is shown separately as a triangle, but in the same color as the sample.

Conclusions

- Most of the original **mine waste** samples contained high levels of As, Pb, and Zn, which **decreased** for some of the **cleaned** mine waste samples (e.g., **FR_3_CL_BIOL**).
- **Metal(loid)s** were most efficiently **immobilized** via physical or chemical encapsulation in **cements/clinkers**.
- High **firing temperatures** of **ceramics** played a major role in **decreasing** the mobility of some metal(loid)s, while **increasing** the mobility of others (e.g., arsenic, potentially via the structural rearrangement of As and Fe).
- Longer **curing times** of the **AAMs** generally improved the **immobilization** of **metal(loid)s**.
- **AAMs** and **cements/clinkers** are highly alkaline with high acid buffering capacities, making them more resistant to metal(loid) release under acidic conditions.

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