HEAVY METAL RELEASE FROM POROUS INORGANIC POLYMERS MADE FROM Fe-RICH SLAG: EFFECT OF Al CONTENT AND CURING TIME

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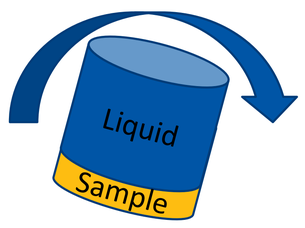
ABSTRACT

Inorganic polymers (IP) can be an alternative environmental friendly insulation block, because of the use of secondary raw materials. A porous IP is synthesized by mixing an industrial Fe-rich slag with an alkaline solution and a gas releasing agent, which shows good thermal insulation properties (i.e. 0.070-0.180 W/mK). One **drawback** of using secondary residues is the **heavy metal content**. However these porous IPs can be a potential immobilization matrix. **In this study, the release of heavy metals is studied in function of the porosity and sample age.**

METHODS AND MATERIALS

A finely milled Cu slag with a Blaine fineness of 5000 ± 400 cm^2/g was used as precursor. The precursor was mixed with an activating solution using a L/S of 0.35 with 0.1 wt% and 0.2 wt% Al (1-5 µm, AEE) and 0.035 wt% sodium oleate (surfactant). After mixing, these samples were cast in 10 cm wide cubes, sealed and cured for 24 h at 40 °C. After curing, the samples were stored for 3 days at 25 °C in sealed conditions. For the leaching, the samples were subsequently crushed at a particle size < 4mm. The dry weight of the crushed samples was determined at 105 °C according to EN 12880. Leaching was studied by using a one stage batch test at a L/S of 10 L/kg according to BS EN 12457-4:2002.[1]

Batch Leaching test



RESULTS

The used slag is mainly characterized by a high FeO and SiO_2 content. **Metals** are present as **main elements** (> 0.1 wt%) are **Cr, Zn and Cu**, respectively (Table 1).

Table 1: Chemical composition in wt% of the precursor

	FeO	SiO_2	Al_2O_3	CaO	P_2O_5	Na_2O	Cr_2O_3	ZnO	MgO	CuO	Others
wt%	40.9	32.3	11	3.9	2.2	2	1.6	1.5	1.4	0.3	2.8

CT images in Figure 1 show that the **porosity increases** from **55 to 80%** by increasing the **Al** content from **0.1 to 0.2 wt%**. The amount and size of the large pores increases by increasing the amount of foaming agent.

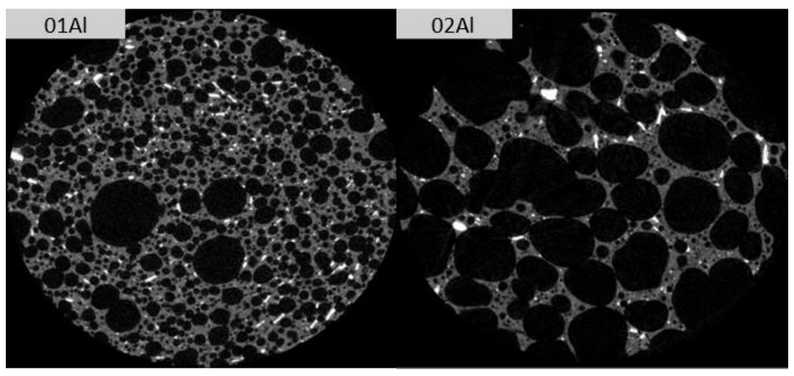


Figure 1: CT-images of the porous samples.

Table 2 shows when the **samples increase in age**, the **pH** and **conductivity decreases** of the leachate. The leachate has a slightly positive oxidation potential, meaning that the chemical species present in the solution are able to oxidize.

Table 2: Properties measured of the material before leaching: The leachate (pH, Ec and Eh).

	pH	EC (mS/cm)	Eh (V)
01Al5d	11.7	2.6	0.283 ± 0.003
02Al5d	11.8	3.0	0.279 ± 0.004
01Al90d	11.1	2.4	-
02Al90d	11.1	2.5	-

The release of **Mo and Se exceeded the legislative limits for non-hazardous waste** according to the European legislation for landfilled wastes (Figure 2). **Trace elements (< 0.1 wt%) present in the slag can be a major bottleneck.** In addition, the data show that **the release of heavy metals** is **similar after 90 d** for all samples.

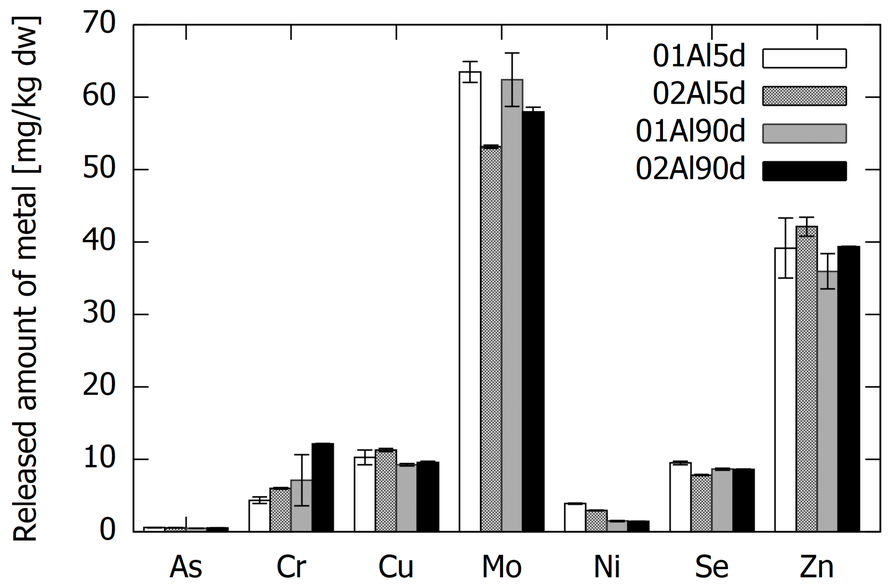


Figure 2: The release of heavy metals according to BS EN 12457-4:2002. The release of Ni decreases significantly with sample age.

Visual MINTEQ indicates that **Ni** could be immobilized as **$Ni(OH)_2$** due to the declining pH with increasing sample age.

Table 3: Moddeled dissolution/precipitation of Ni in solution

wt% Reactive Ni in IP	0.1	0.01	0.001	0.0002
% in solution pH of 11.72	0.6	5.9	46.8	100
% in solution pH of 11.09	0.2	2.1	19.1	69.1

CONCLUSIONS

- ✓ Increasing the foaming agent increased the porosity from 55 to 80%.
- ✓ Increasing the porosity increased the release of ions
- ✓ Release of heavy metals was not dependent on porosity
- ✓ Trace elements can be a bottleneck (Mo and Se)
- ✓ Sample age only significantly influences the release of Ni
- ✓ Ni is probably immobilized as $Ni(OH)_2$

REFERENCES

1. EN 12457-4:2002. Characterisation of waste — Leaching — Compliance test for leaching of granular waste materials and sludges. 2002.

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