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Screening of strontium extraction from different incineration ashes

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Strontium came into the EU list of critical raw materials in 2020 [1]. Critical raw materials are essential to the functioning and integrity of a wide range of industrial ecosystems. The European Green Deal's Circular Economy Action Plan [2] aims to decouple growth from resource use through sustainable product design and mobilizing the potential of secondary raw materials. Still, for Sr, recovery from secondary resources is currently very limited. The end-of-life recycling input rate (EOL-RIR) reflects the total material input into the production system that comes from post-consumer scrap recycling, and it is 0% for Sr [3].

This work explores the possibility of extracting Sr from three different types of incineration ashes. The ashes are: wood fly ash (WFA), sewage sludge ash (SSA), and municipal solid waste incineration (MSWI) fly ash. The experimental work includes two ashes of each type and from different Danish incineration plants.

The total Sr concentrations in the ashes were: WFAs 610 mg/kg and 500 mg/kg, SSAs 2021 mg/kg and 520 mg/kg, and in the MSWI fly ashes 260 mg/kg and 261 mg/kg. Thus, the WFAs and the MSWI fly ashes mutually had concentrations within the same level, whereas the SSAs varied more in Sr concentrations. A four-step sequential extraction was used. It showed very similar patterns for each ash pair but significant differences between the ash types. The SSAs had more than 70% Sr in the residual phase i.e., in the hardest bound fraction, and less than 10% in the first step i.e., easiest to extract. The MSWI fly ash had about 20% Sr in the residual phase and 35% in the first. The WFAs were in-between these two.

Extracting Sr from the ashes in HNO_3 of different concentrations also showed different patterns, and the results were similar for each pair of ashes. At pH 5, about 100% Sr was extracted from the WFAs. At pH 5 the maximum extraction was obtained for the MSWI fly ashes, which was 65%, and no more was extracted even at pH of 0.3. At pH 1 about 100% Sr was extracted from the SSAs.

From the screening of three different ash types performed here, extraction of Sr has the highest potential for WFAs. They contain 500-600 mg Sr/kg, and at a pH of around 5, it was possible to extract about 100% of this resource.

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