Faculty of Material Sciences and
Material Technologies
Institute for Nonferrous Metallurgy and Purest
Materials

TECHNISCHE UNIVERSITÄT
BERGAKADEMIE FREIBERG
Die Ressourcenuniversität. Seit 1765.

MASTER THESIS

H_2-Wälzkiln for CO_2-free Zn recycling

Introduction

The Waelz process is a pyrometallurgical method used to recover zinc from zinc-containing industrial waste, such as electric arc furnace dust (EAFD) and other zinc-bearing residues. It contains up to 30 wt.-% of zinc. This process involves mixing the waste with a reducing agent, typically coke or coal, and heating it in a rotary kiln at temperatures around 1200°C. During this process, zinc is vaporized and then condensed into zinc oxide. The Waelz kiln's rotating motion ensures thorough mixing and reaction of materials. This method effectively recovers zinc while also producing a slag byproduct that can be further processed or disposed of safely. It is expected that in 25 years, the amount of EAFD will reach up to 18 million tons per year. Currently, the Waelz process is realized mainly with carbon-based reducing agents. Alternatively, hydrogen is a potential candidate to replace the used reducing agents. The advantage is in reducing the CO_2 emissions associated to the process. In this thesis, the aim is to research the use of H_2 as a reducing agent to recovery Zn from the EAFD. It will be compared to the efficiency of other reducing agents as graphite and metallurgical coke.

Tasks

- The candidate (f/m/d) starts with short literature research on Waelz process (state-of-the-art reducing agents and current research on H_2 use).
- Usage of FactSage 8.3 (thermodynamic modelling software) for experimental preparation as well as for preparation of proposed flowsheets for material streams.
- Sample preparation and characterization using XRF, ICP, C/S, and XRD analyses of the initial materials and products.
- Conducting the reduction experiments in crucibles (up to 0.5 kg) inside an electrically heated furnace/induction furnace, applying different reduction agents (e.g., graphite, H_2, and metallurgical coke).
- Evaluation of product quality and purity, analysis, interpretation and reporting of the experimental data.

Requirements

- ✓ Basic knowledge in Metallurgy/Material Science/Chemistry or related.
- ✓ Experience and interest in working in the laboratory.
- ✓ **Start Date**: December 2024, Duration: 6 months (40 hours/week).

Benefits

- ❖ Opportunity to gain experience in pyrometallurgy.
- ❖ Contribute to the circular economy and sustainability enhancement.
- ❖ Publication of the relevant results.

Contact

If you have any further questions or are interested to apply, please contact:
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