Charge-induced dry concentration of lithium-containing components in fine slag powders

Contact: Mehran Javadi mehran.javadi@tu-clausthal.de ;
Dr-Ing. Annett Wolmann annett.wollmann@tu-clausthal.de ;
Prof. Dr. Alfred Weber alfred.weber@tu-clausthal.de

Overview

Pyrometallurgical slags are complex material systems with regard to size, composition, and surface properties, which depend on the initial ingredients (including trace contaminants), solidification kinetics, and comminution process. Against this background, a flexible, but the precise sorting process is required to concentrate the target element(s). Here a dry charge-induced sorting technique is proposed, which, in contrast to classical approaches, depends on the particle material properties only and is not influenced by the particle size of the target powder, i.e. avoiding the so-called equal-falling problem ("Gleichfälligkeit"). This will be achieved by charging surface-conditioned powders in defined particle-wall collisions and separating the target particles from the rest in an electrosorting process. As it showed in Fig. 1, the new approach consists in moving the target component into a neutral charge state while all other components remain charged and are removed from the target in the electrosorting (separator) unit.

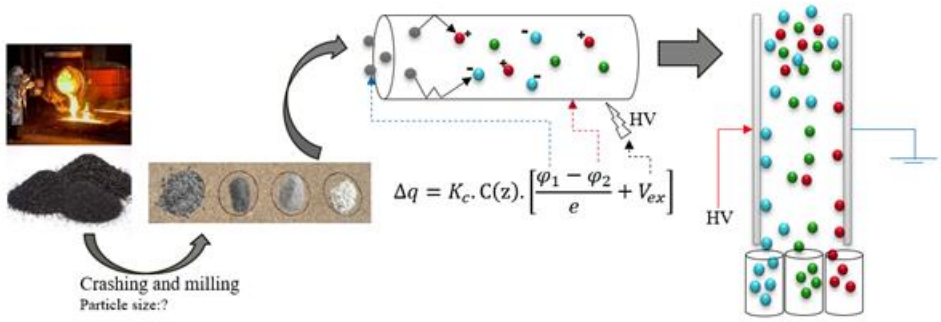

Figure 1: A diagrammatic representation of the process involved in tribocharging powders and separating particle systems

The first sub-goal is an improved understanding of the influence of the potential difference between wall and particle surface on particle contact charging. Hypotheses presented in the literature for well-defined single particle-wall collisions will be tested for dispersed systems with higher particle numbers. By varying the combination of particle and wall material, the mechanisms of charge transfer will be elucidated.

As a second sub-goal, the understanding of different measures of the conditioning on the particle surface properties and their lifetime should be improved. These measures include the DBD plasma treatment in different gases and the adjustment of the relative humidity of water vapor with different degrees of acidity.

The third sub-goal concerns the correlation of the particle properties and the operating conditions on the expression of the bipolarity characteristics of the charge distribution after the particle-wall

collision. Especially the overlap of the charge distributions of different slag components will limit the achievable sharpness of material sorting.

While in the first funding period the understanding of the microscopic processes in the charging by particle-wall collisions is the main focus, the second period will be concerned with the application of the techniques for real EnAM slag particles and with the scale-up, which includes also the modelling of the particle movement in the charger unit and the electrosorter.

particle characterization

This characterization involves evaluating various physical, chemical, and morphological characteristics of particles to understand their size, shape, composition, surface properties, and other relevant parameters. Techniques commonly used for particle characterization include microscopy, spectroscopy, scattering methods, and particle size analysis. Investigation of the morphology and composition of the powder particles is conducting by:

- Thermogravimetric analysis (TGA)
- Scanning electron microscopy (SEM)
- Transmission electron microscopy (TEM)
- Laser diffraction and X-ray diffraction

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