Physical slag properties via a combined experimental-modelling approach

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To strive towards carbon-neutrality, metallurgical industries are focussing on electric furnaces. The pyrometallurgical processes typically oxidize impurities to metal oxides which end up in the slag. One issue in pyrometallurgical processes are metal losses to the slag phase, limiting the process efficiency. To solve this, slag cleaning is required in electric furnaces, which can serve for both decantation and reduction.

In electric submerged arc furnaces, thermal energy is supplied primarily by the Joule effect, which is inversely related to the slag conductivity. Hence, the electrical conductivity of the slag is essential for operating electrical furnaces. Unfortunately, it is a parameter which is very difficult to measure and thus requires a very specific experimental set-up so that data is scarce.

Moreover, increased scrap usage makes the process feed more variable so that the use of a 'digital reactor twin' is put forward as the solution. To make such a digital twin, also other physical slag properties (viscosities, diffusion coefficients and surface tensions) need to be known as a function of temperature, atmosphere and composition. At Ghent University, we propose the use of a combined experimental-modelling approach to provide more and more accurate data on slag conductivities, viscosities and surface tensions so that the structure-property models can be optimized further.