

**K1-MET**

**Competence Center for  
Advanced Metallurgical and  
Environmental Process  
Development**

Programme: COMET – Competence  
Centers for Excellent Technologies

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slag properties”, 2019-07-01 to  
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## EXPERIMENTAL DETERMINATION OF DIFFUSION AND ACTIVITY COEFFICIENTS IN SLAGS

DETERMINATION OF PHYSICO-CHEMICAL PROPERTIES OF SLAGS TO INCREASE  
EFFICIENCY AND PRODUCTIVITY OF HOT METAL AND STEEL PRODUCTION.

Slags are an essential refining agent in hot metal and steel production and treatment. Their composition greatly affects the process efficiency. The rapid formation of a reactive slag with appropriate viscosity, density and chemical composition simplifies the removal of sulphur and phosphorus from the melt. Therefore, investigations of slag physico-chemical properties are necessary for optimising metallurgical processes.

The diffusion coefficient of a dissolved substance in a melt is a fundamental quantity that is needed to describe the dissolution process. To determine the diffusion coefficient, an experimental set-up was developed at the Chair of Ferrous Metallurgy at the Montanuniversitaet Leoben in cooperation with K1-

MET, which allows the dissolution behaviour of slag formers to be investigated. By determining the dissolution rate and applying dimensionless correlations of mass transfer, the diffusivity of oxides in slags can be evaluated. Figure 1 shows the results of calcium oxide (CaO) dissolution experiments in synthetic LD slag. In addition to the series of tests in LD slag, investigations of CaO and magnesium oxide (MgO) dissolution in blast furnace, calcium aluminate and wollastonite slag have also been carried out.

## SUCCESS STORY

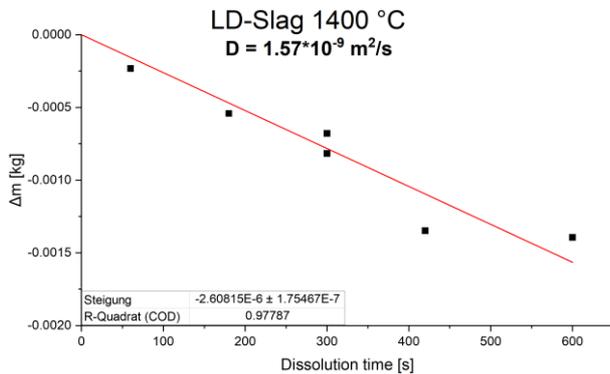


Figure 1: Mass loss of CaO samples as a function of immersion time in LD slag (source K1-MET)

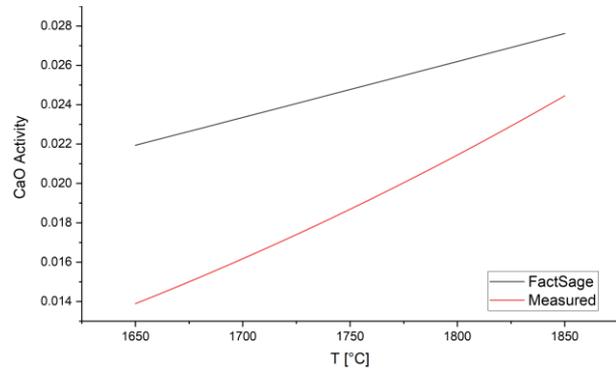


Figure 2: Comparison of the calculated and experimentally determined CaO activity (source K1-MET)

For experimental determination of the activity of CaO in slags, preliminary tests were carried in cooperation at the Jülich Research Centre (Germany) using Knudsen effusion mass spectrometry. The activity of the species to be investigated corresponds to the ratio of the partial pressure of the respective species in the mixture and the partial pressure of the pure substance. Figure 2 compares the determined CaO activity in the slag with the activity calculated using FactSage®. The average deviation of the measured activity from the calculated activity is -0.0059.

### Impact and effects

The possibilities that have been created for the experimental determination of the diffusion coefficient and the thermodynamic activity of various slag formers and generally of oxides in slags allow the data obtained to be implemented in process models and thus permit more precise modelling. As a result, the efficiency and productivity of metallurgical processes can be increased, which in turn leads to savings in energy and production time and contributes to the saving of resources and thus to a reduction in costs.

### Project coordination (Story)

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- Montanuniversitaet Leoben, AT
- University of Applied Sciences - Upper Austria, AT

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