SUCCESS STORY

K1-MET
Competence Center for Excellent Technologies in Advanced Metallurgical and Environmental Process Development

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THE MELTING AND DISSOLUTION BEHAVIOUR OF SCRAP DURING THE LD CONVERTER PROCESS

IN THE LINZ–DONAWITZ OXYGEN STEELMAKING PROCESS (LD), SCRAP ACTS AS A COOLANT AND IRON SOURCE, WHICH DISSOLVES THROUGH A COUPLED HEAT AND MASS TRANSFER IN HOT METAL. THE TARGET OF THIS PROJECT WAS THE DEVELOPMENT OF A NUMERICAL SCRAP MELTING MODEL CONSIDERING A COUPLED HEAT AND MASS TRANSFER.

Experimental Investigation of the scrap melting and dissolution behaviour

The complexity of the scrap melting process starts with the choice of the experimental methodic. At the Chair of Ferrous Metallurgy (Montanuniversität Leoben, CoFM), two high temperature vertical tube furnaces were the main units to melt the hot metal. Through a rotating cylindrical sample, turbulent melt conditions were achieved. Through varying immersion times of the sample into the liquid hot metal and the exact determination of the mass losses, the ablation rate and mass transfer coefficients were determined. Metallographic investigations showed a carbon enrichment at the surface, which was quantified by means of electron microprobe analyses (see **Fig. 1**). Based on these measurements, an improved approach of the diffusive melting method was developed.

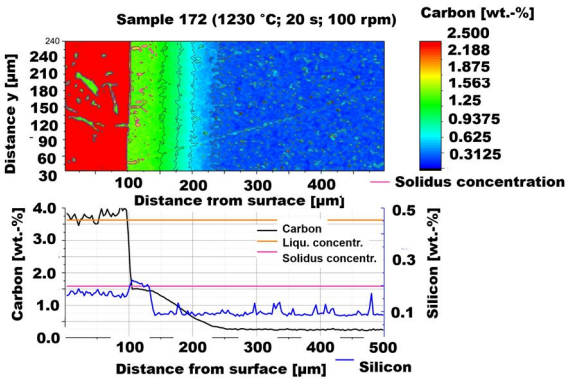

Fig. 1: Carbon distribution at the solid/liquid interface (Hot metal = red area; CoFM, Leoben).

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Development of a numerical model during an outgoing research stay in Brazil

Based on the experimental investigations, a numerical scrap melting model describing the coupled heat and mass transfer was developed. The model describes a seamless transition between the diffusive and forced scrap melting approaches. It is unique that temperature and chemical composition-dependent physical parameters were included. In **Fig. 2**, an example for the predicted evolution of the radius ablation is shown. The blue line defines the first volume element, where the liquid fraction is 100 %. The red line defines the last element, where only solid fraction is included in a volume element.

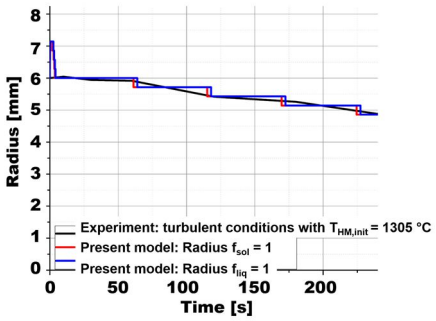

Fig. 2: Comparison of the developed numerical model with the experiments (CoFM).

A good agreement between numerical predictions and experimental was achieved and the radius ablation (black line in **Fig. 2**) was determined. The numerical scrap melting model has also the necessary conjunctions to integrate it into the dynamic LD converter model in future. The global LD process model was developed in the framework of the previous K1-MET funding period.

Impact and effects

The melting and dissolution behaviour of scrap in liquid hot metal massively influences the operation of the LD process. The developed numerical model serves as a basis for the improvement of the dynamic process model. Due to the investigations of the diffusive scrap melting process, new phenomena were identified, which must be in the focus of future research activities. The scientific investigation of the scrap dissolution is a fundamental research activity to improve the global LD process simulations. By an implementation into global process models, scrap resources can be charged specifically, which will result in the economic advantage of reduced production costs and time.

Project coordination (Story)
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