12th K1-MET Scientific Exchange Day

12 April 2023, Graz University of Technology
Campus "Alte Technik", Rechbauerstrasse 12, 8010 Graz, Location: HS I

Main goal of the Scientific Exchange Day (SED) is to present current research activities and results within the COMET K1-MET programme. Furthermore, the SED represents an opportunity to stimulate the interactions between the scientific and the company partners of K1-MET with plenty of time for discussions.

09.00 – 09.35	Come together, Registration
09.35 – 09.45	Welcome and Introduction (CSO Prof. Johannes Schenk)

Presentations from the Research Areas

(Maximum time target: 20 min. Presentation, 10 min. Discussion)

Chairperson: Prof. Dr. Ruediger Deike (University Duisburg-Essen)

09.45 – 10.15	Research Area 1: Elizaveta Cheremisina (K1-MET GmbH) – COMET Project 1.1 "Liquid slag properties density, surface tension, and viscosity of silicate-rich slags measured by non-conventional and conventional methods"
10.15 – 10.45	Research Area 2: Nathalie Gruber (Montanuniversitaet Leoben) – COMET Project 2.5 "Effect of SiC and/or antioxidants on the melting behavior of a mold powder"
10.45 – 11.15	Break

Chairperson: Ass. Prof. Dr. Valentina Colla (Scuola Superiore Sant'Anna)

11.20 – 11.50	Research Area 3: Christoph Spijker (Montanuniversitaet Leoben) – COMET Project 3.3 "Energetic optimization"
11.50 – 12.20	Research Area 4: Xiaomeng Zhang (K1-MET GmbH) – COMET Project 4.1 "Inclusion removal with a focus on particle separation at the steel/slag interface"
12.20 – 12.30	Closing words (CSO Prof. Johannes Schenk)
From 12.30	Lunch and end of 12th K1-MET Scientific Exchange Day

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Abstracts

Research Area 1: Elizaveta Cheremisina (K1-MET GmbH)

"Liquid slag properties density, surface tension, and viscosity of silicate-rich slags measured by non-conventional and conventional methods"

The density, surface tension, and viscosity were measured by aerodynamic levitation (ADL) under contactless conditions and conventional methods combining maximum bubble pressure (MBP) and rotating cylinder (rotating bob method RBM). The silicate-rich slag (44 and 63 mass-% of SiO_2) of the CaO-SiO_2 and CaO-SiO_2-Fe_2O_3 systems (with 5 and 10 mass-% Fe_2O_3) was investigated in the temperature ranges between 800 – 2000 °C. The behavior of Fe^{3+} ions was examined considering different bonding, role of cations, and complex ionic interactions. Raman spectroscopy was applied to provide structural data of the polymer melts. Urbain's viscosity model and FactSageTM 7.3 were used to assess the experimental data.

Research Area 2: Nathalie Gruber (Montanuniversitaet Leoben)

"Effect of SiC and/or antioxidants on the melting behavior of a mold powder"

For low carbon steels, recarburization results in a significant change of the product quality. Thus, carbon-free mold powders or powders without elementary carbon are required. Thermodynamic calculations of the mold powder and different mixtures of SiC with and without antioxidants were carried out. To verify the results also under high heating rates, the mixtures filled into steel crucibles with a lid were inserted into the preheated furnace at selected temperatures between 900 – 1200 °C for 10 min. Afterwards, the quenched samples were investigated mineralogically. The results show that SiC can properly replace carbon, but its effect is significantly reduced when adding antioxidants.

Research Area 3: Christoph Spijker (Montanuniversitaet Leoben)

"Energetic optimization"

The requirements for industrial furnaces and burners in terms of efficiency and emissions are constantly increasing. One approach to solve this problem is the digital modelling of the processes. Using fast calculating implicit mulit-1D models, which are called "FastCalc", the behavior of a kiln plant can be described in a short time. These models are suitable for parameter studies or production planning at the industrial partner. Furthermore, the process can also be described in detail using Computational Fluid Dynamic methods. This allows an improvement of the process on a detailed level. Here, the focus is on energy efficiency, reduction of nitrogen oxide emissions, and CO_2 reduction through hydrogen admixture.

Research Area 4: Xiaomeng Zhang (K1-MET GmbH)

"Inclusion removal with a focus on particle separation at the steel/slag interface"

The interaction between inclusion particles and the steel-slag interface is a crucial aspect of the inclusion removal process and can have a significant impact on removal efficiency. However, this interfacial phenomenon is often overlooked or underestimated. In this study, numerical simulations are conducted, which allow us to visualize the dynamic interactions between the particle/fluid interface and identify the most influential factors governing particle separation. Together with experimental observations from the HT-LSCM, we have gained valuable insights into the phenomena of small particles interacting with a fluid-fluid interface. The results are also useful for large-scale simulations, which can be incorporated as a boundary condition to better estimate the inclusion removal situation.

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