14th K1-MET Scientific Exchange Day

23 – 24 April 2025, Vienna University of Technology (TU Wien),
Room TUthesky (Keynote) and GM5 (SED), Getreidemarkt 9, 1060 Vienna

Main goal of the Scientific Exchange Day (SED) is to present current research activities and results of K1-MET and its partner network. 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.

23 April 2025 Keynote

17.00 – 17.30	Keynote: Prof. Ruediger Deike (University Duisburg – Essen, Member of the Scientific Advisory Board) "How has the steel industry developed over the last 50 years, and can we learn anything from it in the future?"
17.30 – 19.00	Get together

Abstract Keynote: Ruediger Deike

"How has the steel industry developed over the last 50 years, and can we learn anything from it in the future?"

Until the 1970s, economic development in Europe and the world was characterised by the dominance of industrial production, i. e., the secondary sector. This extremely rapid development of the industrial sector has led to a drastic increase in the consumption of energy and raw materials in the market-oriented Western world, as well as to extreme environmental pollution, which threatened to destroy the livelihoods of the current and future generations. In the light of these experiences, a fundamental change in thinking has taken place in Europe and other parts of the Western world, which has led to far-sighted thinking in large sections of society and politics becoming the maxim for social action and decision-making today. Contrary to all forecasts, this has significantly improved environmental protection and thus improved working and living conditions, particularly in industrial conurbations, over the last five decades. Furthermore, the traditional industrial nations in Europe and Japan underwent a structural transformation from industrial to service-based societies in the 1970s, which resulted in changes in the consumption of raw materials in these regions. From the mid-1990s and increasingly from 2003, China's industrialization has led to changes in the market structures on the supply and demand side in non-energy raw materials, which have subsequently led to extreme price fluctuations at very short intervals and will go down in economic history. Based on current knowledge, it can be assumed that China is undergoing a structural change from an industrial to a service-based society, which will significantly influence the development of the commodity markets over the next two decades.

24 April 2025 14th Scientific Exchange Day

10.00 – 10.30	Registration and Come together
10.30 – 11.30	Opening words and panel discussion "Future project landscape of K1-MET"

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Panel discussion "Future project landscape of K1-MET"

Moderator: MMag. Elisabeth Eidenberger

Panel participants	Nina Kieberger (voestalpine Stahl GmbH) Àngels Orduña (SPIRE Association) Stephan Bauer (RAG Austria AG) Peter Karner (voestalpine Stahl Donawitz GmbH) Markus Lehner (Montanuniversitaet Leoben) Walter Martinelli (SCHOLZ Austria GmbH) Thomas Prietl (RHI Magnesita GmbH)
11.30 – 11.45	Break
11.45 – 13:00	Interactive discussion "Ideas for future COMET funding period"
13:00 – 14:00	Lunch

Success Stories COMET

Moderator: MMag. Elisabeth Eidenberger
(Maximum time target: 15 min presentation, 5 min discussion)

14.00 – 14.20	Success Story Area 1: Daniel Kavic (K1-MET) "Potential of a hybrid through-process approach for adaptive quality control in ladle treatment of steel"
14.20 – 14.40	Success Story Area 2: Christa Muehlegger (K1-MET) "Assessing decarbonization pathways for the steel industry using process simulation"
14.40 – 15.00	Success Story Area 3: Mohammad Karimi Zand (K1-MET) "Unravling bubble lift force emergence using general vorticity transport equation"
15.00 – 15.30	Closing words (Management Board)

Abstract Success stories

Research Area 1: Daniel Kavic (K1-MET)

"Potential of a hybrid through-process approach for adaptive quality control in ladle treatment of steel"

A hybrid through-process approach integrating metallurgical modeling and statistical learning to enhance adaptive quality control in ladle treatment of steel (BOF tapping, ladle furnace, and RH degasser) is being developed. Applying the Effective Equilibrium Reaction Zone method to capture the reaction kinetics within a system of interest, the model predicts phase compositions and quantifies the enthalpy effects of chemical reactions, while statistical techniques analyze key process parameters affecting temperature control and define the recovery rates of alloying materials. This novel hybrid approach demonstrates superior predictive accuracy, paving the way for future optimization of critical metallurgical processes, such as desulphurization and degassing under varying initial conditions.

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Research Area 2: Christa Muehlegger (K1-MET)

"Assessing decarbonization pathways for the steel industry using process simulation"

The flowsheet simulation software gPROMS (General PROcess Modeling System) is used to model and evaluate potential transformation scenarios for an integrated steel mill to achieve carbon neutrality. The transition from the carbon-intensive Blast Furnace – Basic Oxygen Furnace route to Electric Arc Furnace-based steelmaking is simulated, incorporating hydrogen-based Direct Reduction, an Electric Smelting Furnace, and carbon capture and utilization technologies. The results of the scenario simulation highlight key challenges in decarbonizing the steel industry, such as the need for significant amounts of affordable green electricity and hydrogen.

Research Area 3: Mohammad Karimi Zand (K1-MET)

"Unravling bubble lift force emergence using general vorticity transport equation"

The lateral distribution of bubbles in liquids is influenced by the lift force acting on them. This lift force arises from the vorticity, which is characterized by a rotation happening in fluid flow. In this study, we explore how bubble deformation and surface tension forces contribute to vorticity generation near the bubble surface and ultimately give rise to the lift force, which causes the lateral motion of the bubbles rising in liquids. Through simulations of individual, freely rising bubbles of varying sizes in different liquid environments – spanning a broad spectrum of fluid flow conditions and properties – using the interface-resolved volume of fluid (VOF) method, we observe a strong correlation between vorticity generation from surface tension forces and the lateral force experienced by the bubble. These findings suggest a fundamental link between these processes and offer a promising pathway to develop a new lift force model, which could be used for modeling the bubble dynamics with better accuracy in complex multiphase scenarios such as gas injection into metal melts.

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