

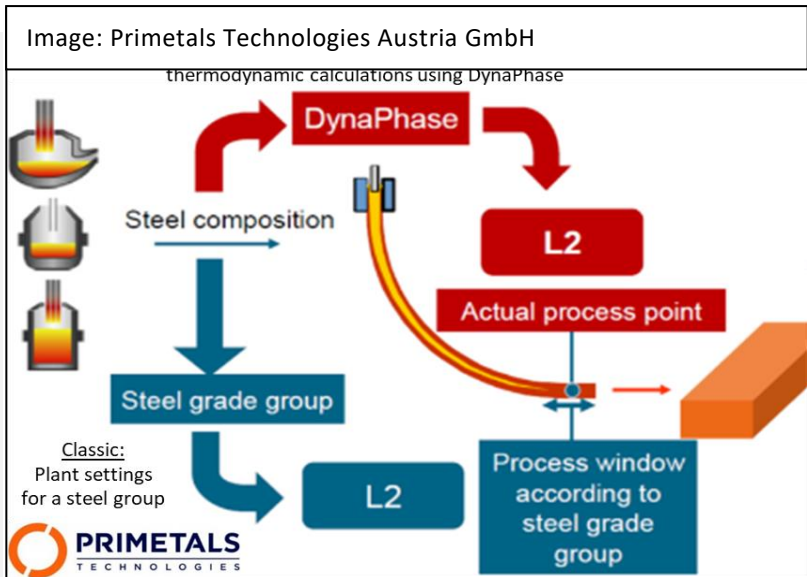
IC-MPPE / Integrated Computational Materials Process and Product Engineering

Programme: COMET – Competence Centers for Excellent Technologies

Programme line: COMET-Centre (K2)

Project P3.1 „Smart process control systems for casting processes“

Multi-firm Project (2016-2020)



USING HIGH TEMPERATURE THERMODYNAMICS FOR BETTER STEEL QUALITY

NEW THERMODYNAMIC DATA OF STRONGLY SEGREGATING PHOSPHORUS ALLOWS BETTER PROCESS CONTROL FOR QUALITY IMPROVEMENT

More than 90% of the world's steel production is based on the continuous casting process, and successful process control has a significant influence on the quality properties of the end product. Continuous casting is therefore also a key process at voestalpine Stahl GmbH in Linz and of great importance for the plant manufacturer Primetals Technology Austria GmbH. Both companies maintain a long-standing research cooperation with the Chair of Iron and Steel Metallurgy at the University of Leoben.

Within the joint project P3.1 a new thermodynamic description of the element phosphorus during solidification of steel was developed. For this purpose, a large number of laboratory samples of the iron-carbon-phosphorus system in the high

temperature range up to 1600°C were examined in order to construct new phase diagrams.

In times of increasing digitalization of the continuous casting process, the availability of high-precision phase diagrams is of great importance. Especially for process control and quality prediction, knowledge of reliable thermo-dynamic data of the currently produced melt plays a key role in addition to numerical algorithms. These data sets should be valid for a wide concentration range in order to be able to describe future alloys. The reliable determination of the thermo-dynamic data is a great experimental challenge due to the high temperatures of over 1550°C and the high reactivity of the melt with the environment.

SUCCESS STORY

Impact and effects

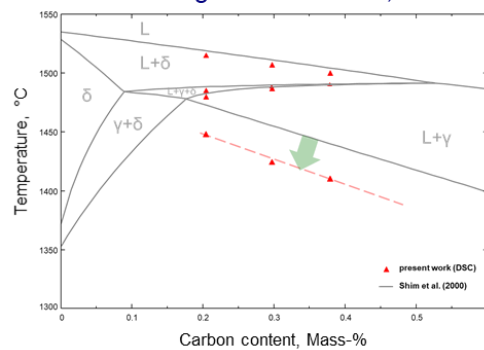
The high-precision data newly determined by means of dynamic differential calorimetry, laser confocal microscopy and X-ray diffraction clearly show that at higher phosphorus and carbon contents the previous temperatures of the melt equilibria were overestimated.

Based on thermodynamic data - measured at the Chair of Iron and Steel Metallurgy - Primetals Technology Austria GmbH further developed the software product "DynaPhase". At voestalpine Stahl Linz GmbH. "DynaPhase" enables a simulation of the continuous casting process during production, based on the current process parameters.

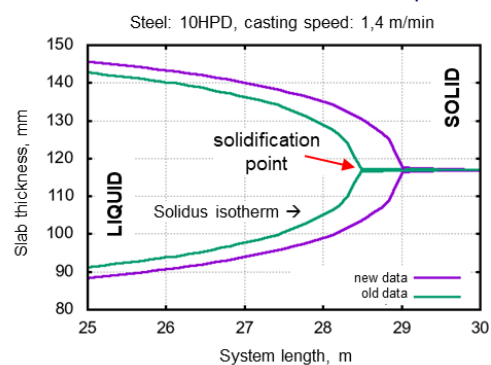
Calculations with the new phosphorus database show significant differences in the solidification point of phosphorus-alloyed steels.

The exact knowledge of the solidification point in the continuous casting plant is the basis for process safety, the technical design of the continuous casting plant, the process control and the internal quality of the cast end product.

Phase diagram: Fe – C – 0,1%P



Calculation of the solidification point



Fe-C-0.1% P phase diagram and the impact on the solidification point in the continuous casting process
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Project coordination (Story)

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This success story was provided by the centre management and by the mentioned project partners for the purpose of being published on the FFG website. IC-MPPE is a COMET Centre within the COMET – Competence Centers for Excellent Technologies Programme and funded by BMK, BMDW, and the federal states of Styria, Upper Austria and Tyrol. The COMET Programme is managed by FFG. Further information on COMET: www.ffg.at/comet