SUCCESS STORY

K1-MET SusMet4Planet Competence Center of Sustainable Digitalized Metallurgy for a Climate Neutral and Resource Efficient Planet

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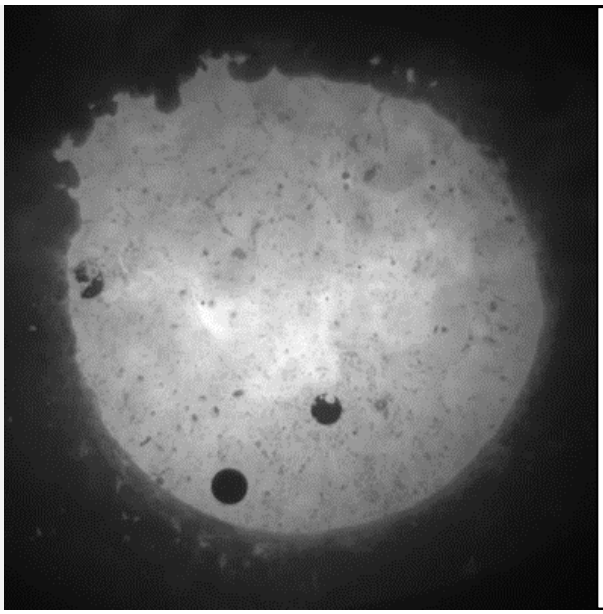


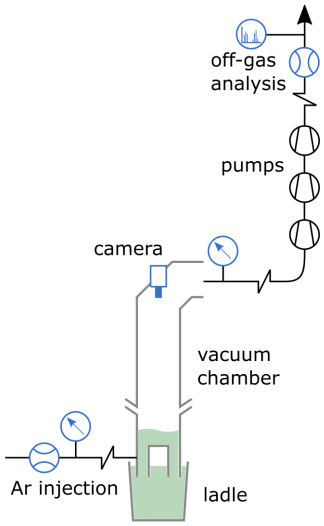
Interaction of the steel melt with hollow steel spheres in the vacuum chamber (© K1-MET, voestalpine Stahl GmbH)

MAKING RH FIT FOR GREEN STEEL PRODUCTION

IMPROVING PROCESS MONITORING IN THE STEEL PLANT

The new demands arising from the need for green steel production, like the increased use of scrap, and a shift to electric steel production, lead to an increase in the variety of crude steel compositions and accordingly the need for secondary metallurgy. In voestalpine the Ruhrstahl-Heraeus (RH) vacuum degasser is a key vessel in secondary metallurgy. Accordingly, it will become a bottleneck vessel in the near green steel future. To speed up this process, it is necessary to improve the process monitoring.

Monitoring the RH process is difficult due to the high temperature of the molten steel and the harsh environment in the steel plant. Nonetheless, it is possible to monitor the liquid melt surface inside the vacuum chamber with a camera mounted nine meters above it. At the moment, this camera is mainly used by the operator to observe the process.



Sketch of the RH-plant. The green part indicates the liquid steel phase. The blue symbols indicate the most important measurement devices at the plant (© K1-MET).

Federal Ministry
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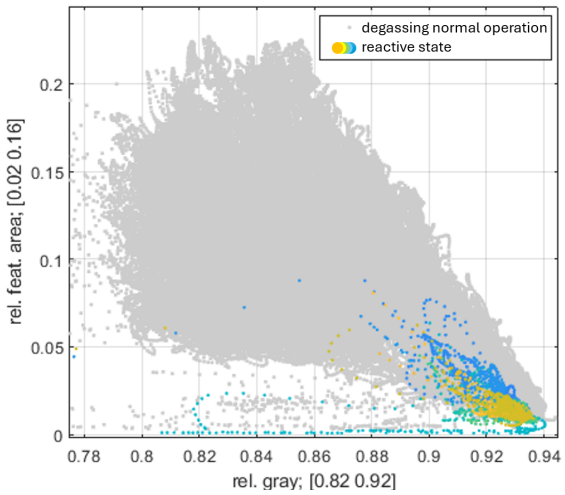

Two parameters from image processing to detect reactive states. The grey dots in the background show normal degassing behavior. The colorful dots in the foreground show the image processing parameters during reactive states (© K1-MET)

By temporarily mounting a high-speed camera at this position and adding hollow steel spheres to the melt, it was discovered that the liquid steel in the chamber forms highly dynamic foam. This foam is a steel-gas mixture with a large gas volume fraction.

In addition, distinct differences in the melt appearance between reactive states and degassing states have been detected. These differences can also be detected in images from a permanently installed camera as shown in the image to the left.

Impact and effects

The foam in the chamber leads to a much larger inter-facial area being available for metallurgical reactions in the chamber. The discovery of foam in the chamber and the quantification of the resulting melt level range is used in reaction calculations and improves prediction models.

The detection of different process states from the camera images in combination with information on the current process step derived from process data is a valuable tool to detect plant malfunctions at early stages and thus reduce down-time and damage to the vessel.

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