

**K1-MET
Competence Center for
Advanced Metallurgical and
Environmental Process
Development**

Programme: COMET – Competence
Centers for Excellent Technologies

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SUSTEEL - SUSTAINABLE STEEL WITH HYDROGEN PLASMA

STEEL IN ONE PROCESS STEP AND EVEN CO₂ FREE? THE HYDROGEN PLASMA
SMELTING REDUCTION PROCESS (HPSR) MAKES IT POSSIBLE!

The idea of using hydrogen instead of carbon as a reducing agent for steel production is not new. Initial research projects were launched as early as the 1970s. Nevertheless, the premiere for a larger reactor was delayed until 2021 (see Figure 1). In cooperation with the Montanuniversitaet Leoben, voestalpine Stahl, and voestalpine Stahl Donawitz, K1-MET succeeded in building and operating the first HPSR reactor with a melting volume of ~100kg of steel.

The HPSR process is the only technology in the world that can produce steel in one step from fine iron ores using hydrogen and electrical energy. The use of fine iron ores is an important component in this process, as the agglomeration processes normally required, such as sintering or pelletizing, are not necessary. This

leads to a decisive energy advantage for the process compared with the current production route via blast furnace and LD converter.

The process development was based on numerous laboratory tests at the Montanuniversitaet Leoben (Chair of Ferrous Metallurgy). These demonstrated the functional concept and created the groundwork for the project's current success. The ambitious project to decarbonize the steel industry entered the design and planning phase as early as 2017. At this time, it was evident that the needed 80-95 percent reduction in CO₂ emissions, which is now stipulated for the EU's climate neutrality in the Green Deal by 2050, would be possible using this technique.

SUCCESS STORY

Initial test runs of the plant in March 2021 demonstrated that this technology can be implemented on a larger scale. Figure 2 shows reduced material from the test reactor. The material could already be partially reduced to almost 100% pure iron. However, further study is required before the next larger plant capacity can be planned. The devil is frequently found in the details.

Impact and effects

Sustainable Steelmaking using the HPSR process provides a solution for the future ambitious requirements of climate neutrality for the steel industry. The basic principle of directly avoiding carbon as a feedstock in the process guarantees a sustainable and climate-friendly alternative to the current steelmaking process.

In addition to the ecologically beneficial aspects of the process, the cost-effectiveness of a fully integrated plant on an industrial scale is one of the key points in favor of using the technology. By eliminating upstream processes for agglomerating the fine ore and by producing steel in just one step, as well as establishing a hydrogen-based energy

system, the chances are good that the economic advantages of the process will also speak in favor of using the technology in the future.



Figure 1: HPSR plant at the voestalpine Stahl Donawitz site (Source voestalpine AG)

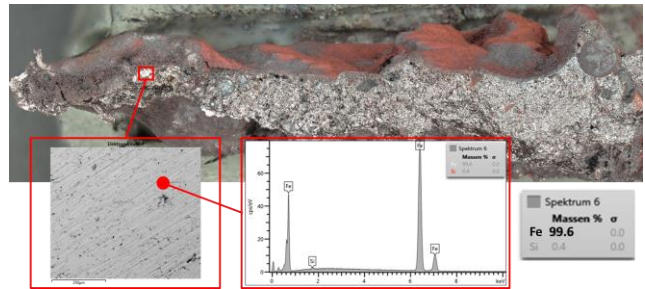


Figure 2: SEM-EDX analysis of the reduced material from the HPSR process (Source K1- MET GmbH)

Project coordination (Story)

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