MaxH2DR newsletter

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Maximise H2 Enrichment in Direct Reduction Shaft furnaces

The project falls under the funding programme of Horizon Europe – Clean Steel Partnership.

The call topic is related to Carbon Direct Avoidance in steel: electricity and hydrogen-based metallurgy.

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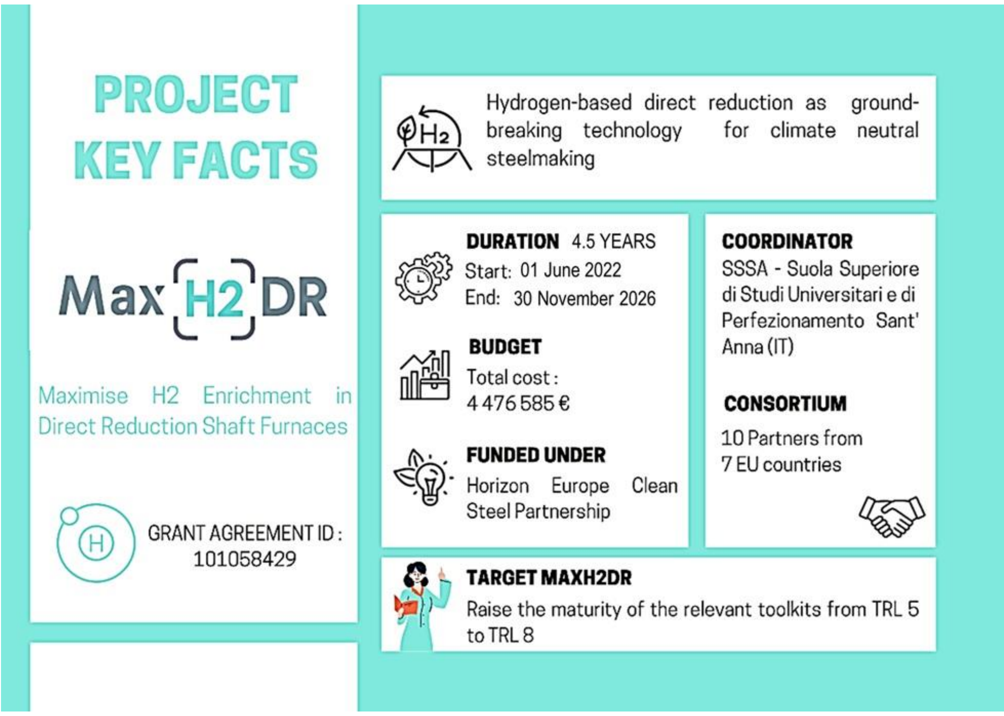
This project has received funding from the European Union under grant agreement n°101058429

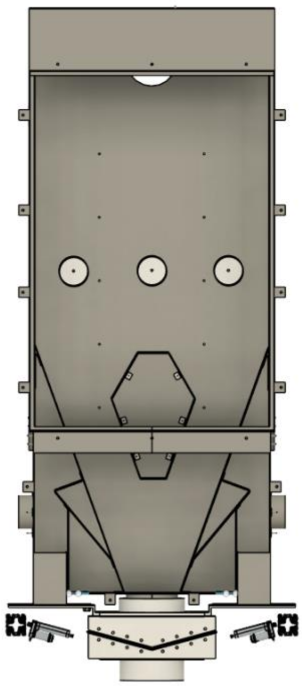


Understanding how iron pellets flow in direct reduction shaft furnances

In hydrogen-based steelmaking, small iron ore pellets are loaded into a 3 m high shaft furnace. They slowly move downward while hot hydrogen gas flows upward, reacting with the pellets to turn them into iron. But what happens as these pellets reach the bottom of the furnace?

At Ruhr-University Bochum (RUB), researchers are using powerful computer simulations to study how pellets move and flow as they exit the furnace. These movements are important to understand because they affect how smoothly the whole system runs—and whether the process can stay energy-efficient and clean.

The project partners from BFI looked at how fast the pellets were moving at the Midrex-based shaft construction located in their institute. In one test, real experiments showed that pellets descended at a rate of 15.4 millimeters per second when no gas was flowing. Simulations at RUB closely matched this, helping confirm that the virtual model is realistic. They also studied how gas moving through the furnace affects the velocity of the particles and pressure inside the shaft, which are key for a safe and efficient reaction.



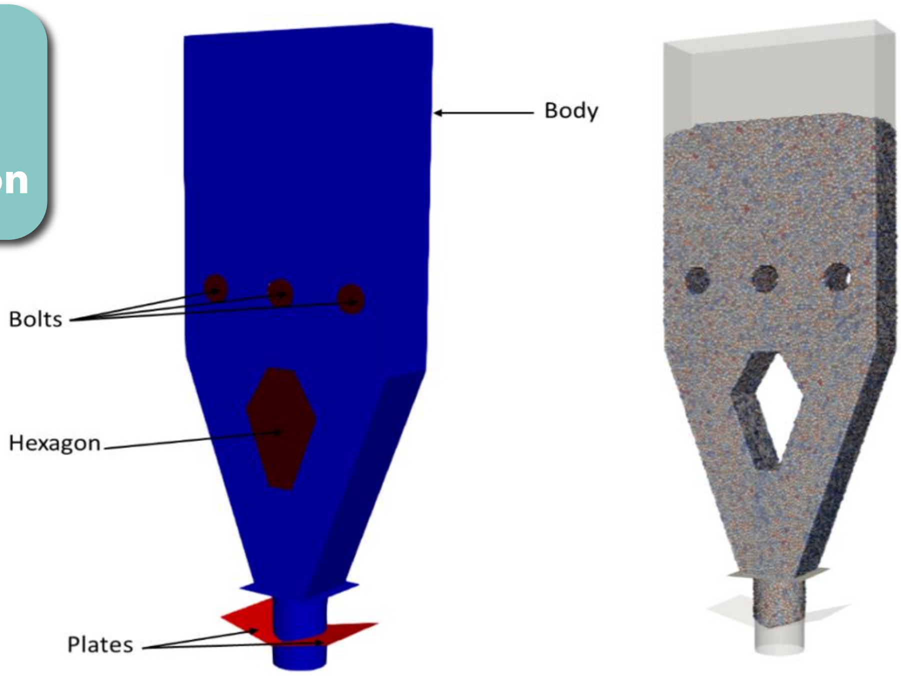
How do iron ore pellets move in the shaft furnace?

One of the most revealing parts of the research at RUB is a computer-generated video that shows how fast the iron pellets move inside the furnace. In the simulation, the pellets cascade downward under gravity, while interacting with the gas around them and with each other. Each pellet's velocity (its speed and direction) is tracked in real time.

The video illustrates that pellet movement is not uniform. Some areas show faster flow where particles can move freely, while other zones are slower due to clogging or friction near walls or obstacles. This dynamic behavior is important because it affects how evenly the hydrogen gas can reach and reduce the iron ore. The researchers use this data to adjust the furnace geometry and operating conditions—ensuring smoother flow, better reduction, and more efficient hydrogen-based steelmaking.

Understanding how fast and smoothly pellets move through a hydrogen furnace helps engineers design better systems for making low-emission steel. Thanks to this research, the MaxH2DR project is one step closer to making clean, hydrogen-based steel production a reliable and scalable reality.

Whatch the video of the Computer simulation



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