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Udine (ITALY)

How decarbonisation, digitisation and circular solutions forge the sustainable European steel future?

INCREASED METALLIZATION IN A SHAFT FURNACE EQUIPPED WITH A CHRISTMAS TREE

Antoine Marsigny
PhD student
antoine.marsigny@univ-lorraine.fr

Olivier Mirgaux
Associate professor
olivier.mirgaux@univ-lorraine.fr

Fabrice Patisson
Professor emeritus
fabrice.patisson@univ-lorraine.fr

Institut Jean Lamour
Université de Lorraine
Nancy, France

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SHAFT FURNACE TECHNOLOGY

- 3.5% of global crude steel production derives from the operation of shaft furnaces
- Shaft furnaces convert iron ore at the solid state with **H_2 and CO**

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- Reduction of iron ore is **exothermic with CO and endothermic with H_2**
- Metallization is limited by **heat supply issues at the center of the reduction zone in H_2 shaft furnaces**

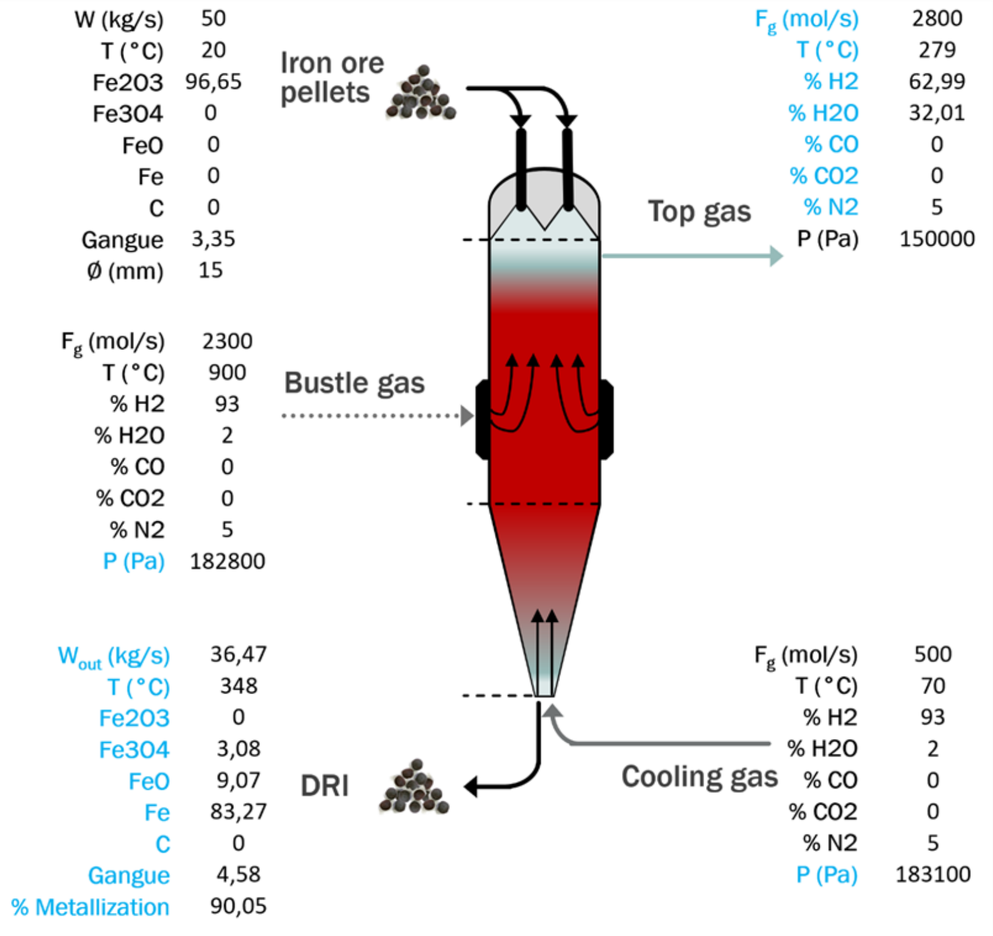
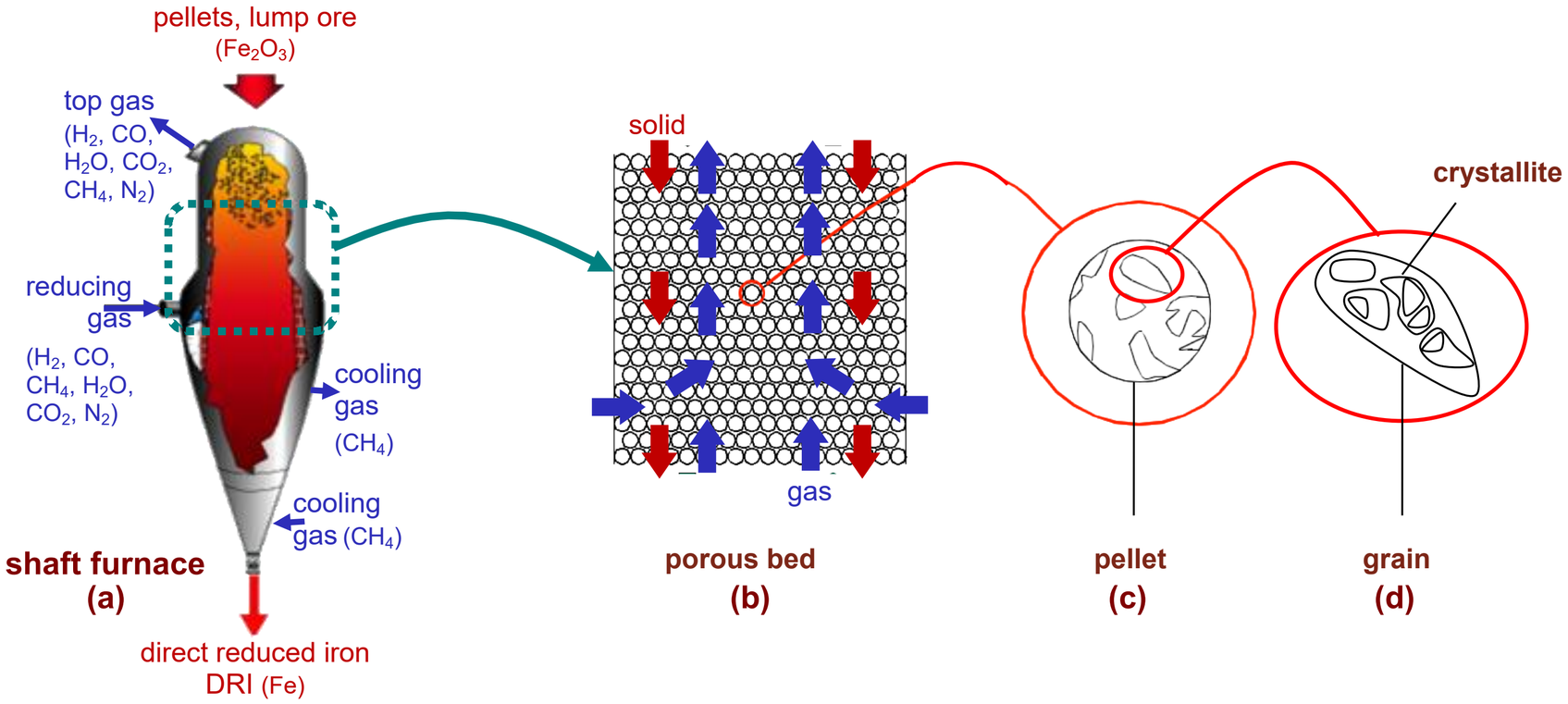


Figure: Mass and energy flowchart of a high-throughput H_2 shaft furnace given as an example. Output data are highlighted in light blue.

SHAFT FURNACE SIMULATION TOOL « REDUCTOR »

- Simulation of syngas and H_2 shaft furnace
- 3 zones : reduction, transition and cooling zone
- Multi-scale model, from the reactor to the grain scale

- Heat and mass balances solved using the finite-volume method (CFD)
- 2-D, axial symmetry, steady state
- Model has been validated against plant data



IMPROVING THE HEAT SUPPLY AND THE METALLIZATION

- Heat supply can be improved by **redirecting 20% of the bustle gas into a central gas injection on the Christmas tree**
- This leads to a surge in metallization (+5.3% in the simulations below)

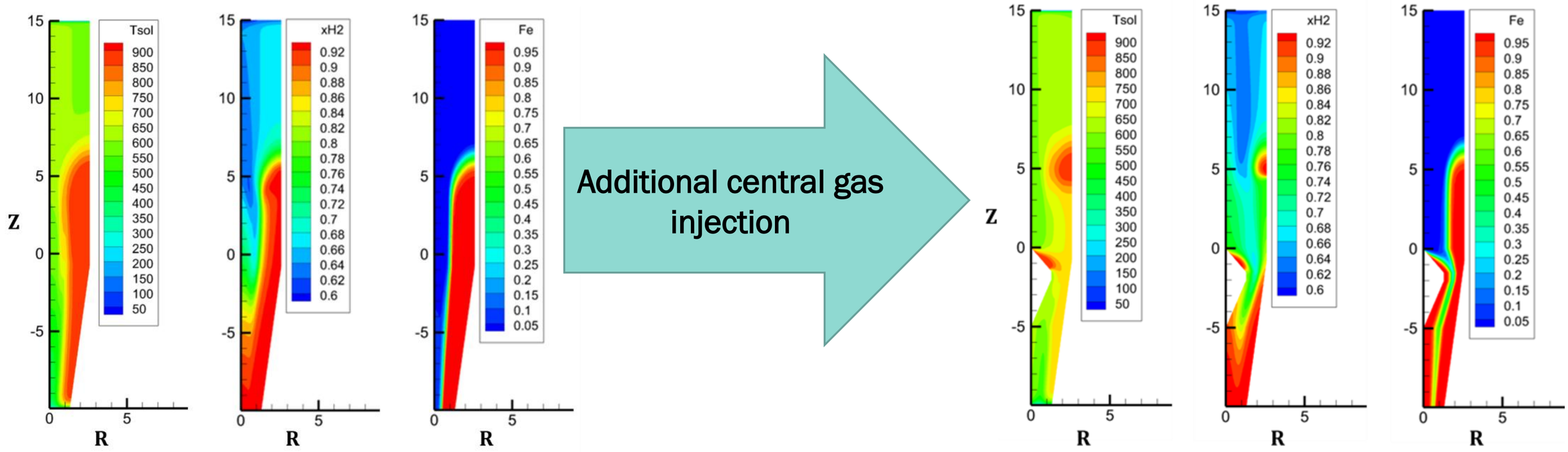


Figure: Simulation results for the operation of a H_2 shaft furnace either with or without an additional central gas injection (resp. right or left graph). For each configuration, the solid temperature, H_2 and Fe distributions are given.