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High-Performance Computing for Multiphase Flow Modelling of Oxygen Lancing in Pyrometallurgical Tap-Holes

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High-performance computing (HPC) provides the means to translate complex multiphase flow data into insight that can inform industrial decision-making. This research applies advanced computational fluid dynamics, executed on the CHPC Lengau cluster, to model reacting gas–liquid systems relevant to oxygen lancing in pyrometallurgical tap-holes. The approach couples open-source CFD solvers with thermochemical data to capture flow behaviour, heat transfer, and reaction-driven gas evolution in molten metal–slag systems. Ferrochrome smelting serves as a representative case study, enabling validation against plant data and illustrating the broader relevance of the modelling framework to other high-temperature processes. By integrating computational models, large-scale data handling, and parallel analysis workflows, the study demonstrates how national cyber infrastructure can transform high-fidelity simulations into actionable understanding for safer, more efficient, metallurgical operations.

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