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Flow and solidification modeling in continuous casting of steel: an European expertise mapping at a glance and positioning at a global level

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Recent advancements in modelling, involving approach and computing power, are transforming the industrial, and particularly the metallurgy sector, providing more precise tools for quality control and process optimization
In the context of continuous casting of steel, modelling techniques provide for an accurate optimization of the process parameters, such as casting speed, layout geometry and secondary cooling, to minimize surface and internal defects as cracks and segregations. Moreover, the use of advanced numerical simulations and thermal analysis helps predicting dendritic structures and undesired porosity occurrence, thereby allowing to improve the quality of the final product. In general, the modelling approach can involve fundamentals of thermodynamics, solidification kinetics, fluid dynamics highlighting the interplay among heat flow, mass transfer, and thermal stresses, also finalized to predict microstructure formation and defect control. The integration of advanced technologies, such as artificial intelligence and machine learning, is opening new frontiers in solidification modeling, allowing for greater precision and adaptability of models to various production processes, as well as in setting up tools integrated with dedicated sensoring for online process and quality control
A comprehensive review of solidification modelling in continuous casting, developed in the frame of an EU - RFCS funded project (METACAST) is then presented to map at a glance, approaches and research groups present in Europe, to identify common lines between models and compare EU expertise with non-EU ones.

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