Contribution ID: **53** Type: **Oral Presentation**

On Modelling Electromagnetic Braking in Thin Slab Continuous Casting: fundamentals, applications, and outlooks

Tuesday, 24 September 2024 14:30 (20 minutes)

Continuous casting (CC) became the world-leading technology for steel production. The thin slab casting (TSC) features a slab shape close to the final products, which are cast at high speeds and rapid solidification rates. The quality of the thin slabs is defined by the turbulent flow pattern and superheat distribution influencing the growing solid shell. To control the fresh melt feeding through the submerged entry nozzle (SEN), electromagnetic brake (EMBr) technology is commonly applied. Numerical modelling is a perfect tool to investigate the EMBr effects during the TSC process. In the presented work we gather results from the long-term studies, which are mandatory to correctly tackle considered multiphase phenomena: (i) interaction of a turbulent jet with the DC magnetic field; (ii) coupling the turbulent flow, heat transfer and solidification with the effects of magnetohydrodynamics (MHD) in the CC mold; (iii) influence of the conductive solid shell presence on the induced electric current distribution and action of the Lorentz force; (iv) flow regimes and superheat transport under growing Hartmann number, (v) outlooks on the adjustable flow controls and solidification using EMBr technique. The presented studies are performed using an in-house implementation of the MHD model using the open-source CFD package OpenFOAM®.

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Session Classification: Session 4

Track Classification: Metallurgical Applications of MHD