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EFFECT OF A ROTARY ELECTROMAGNETIC STIRRER ON STEEL FLOWS WITHIN A SQUARE BILLET MOLD

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A Computational Fluid Dynamics (CFD) model, together with an electromagnetic field model, were developed to investigate synergies between a low frequency rotating magnetic field and a multi-ported SEN, in affecting turbulent fluid flows within a slightly curved, square billet mold. For this purpose, two commercial software packages ANSYS Fluent and COMSOL, were used to discretise and to numerically solve the related governing equations. In the CFD model, the Realizable k- ϵ turbulence model was used to simulate the turbulent fluid flows within the mold cavity, owing to its capability in predicting vortices generated within this region, and compared to the Standard k- ϵ turbulence model [2]. Moreover, a five ported SEN were used to feed the liquid steel into the mold cavity. The validation of the numerical models were accomplished by comparing the present computational results against previous experimental data [3, 4].

According to the computational results, the in-mold rotary EMS creates swirling flows at the midsection of the mold region. These shearing flows are expected to influence solidification microstructures, and the transition from Columnar to Equiaxed. However, this rotating magnetic field does not have a positive influence on damping the strong upward flows and vortices near the liquid steel meniscus, that are caused by the type of Submerged Entry Nozzle (SEN) used in this study. Moreover, due to the curvature of the square billet mold, the effect of the rotary EMS is not identical for fluid flows being generated near the different walls of the mold.

In summary, the In-mold EMS generated a uniform swirling flows within the midsection of the square billet mold, where the EMS unit was installed. However, this EMS does not play any role in creating uniform fluid flows within the mold regions above the immersion depth of the five ported SEN that are required for diminishing mold powder entrainment.

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