Video S1: MHD flow with electrically insulated mold and immersion depth of 100 mm

This video presents the MHD flow modelling results inside an electrically insulated continuous casting mold under the applied EMBr. The self-inducing MHD vortex structures, aligned with the magnetic field, are causing the instability, and waving of the free surface.

Video S2: MHD flow with electrically insulated mold and immersion depth of 50 mm

This video presents the MHD flow modelling results inside an electrically insulated continuous casting mold under the applied EMBr. The self-inducing MHD vortex structures, aligned with the magnetic field, are causing the instability, and waving of the free surface. Due to the shallow SEN immersion depth the MHD vortices are restricted in the vicinity of the free surface, which leads to their destruction.

Video S3: MHD flow at presence of semi-conductive shell and immersion depth of 100 mm

This video presents the MHD flow modelling results inside an electrically insulated continuous casting mold at the presence of the solid shell. The induced electric current density paths tend to close through the conductive solid, leading to the moderate braking effects from the applied EMBr.

Video S4: MHD flow at presence of semi-conductive shell and immersion depth of 50 mm

This video presents the MHD flow modelling results inside an electrically insulated continuous casting mold at the presence of the solid shell. The induced electric current density paths tend to close through the conductive solid, leading to the moderate braking effects from the applied EMBr. Due to the shallow SEN immersion depth, the attached solid is partially above the meniscus. The e-current lines, going above the free surface remain inside the conductive shell.