Supplementary Material for:

Generation of Reverse Meniscus Flow by Applying an Electromagnetic Brake

Alexander Vakhrushev[1], Abdellah Kharicha[1*], Ebrahim Karimi-Sibaki[1], Menghuai Wu[2], Andreas Ludwig[2], Gerald Nitzl[3], Yong Tang[4], Gernot Hackl[4], Josef Watzinger[5], Sven Eckert[6]

*Corresponding author: Abdellah Kharicha abdellah.kharicha@unileoben.ac.at

[1]Christian Doppler Laboratory for Metallurgical Applications of Magnetohydrodynamics, Montantuniversität Leoben, Franz-Josef-Strasse 18, A-8700 Leoben, Austria

[2]Chair of Simulation and Modeling of Metallurgical Processes, Montantuniversität Leoben, Franz-Josef-Strasse 18, A-8700 Leoben, Austria

[3]RHI Magnesita GmbH, Kranichberggasse 6, A-1120 Vienna, Austria

[4]RHI Magnesita Technology Center, Magnesitstrasse 2, A-8700 Leoben, Austria

[5]Primetals Technologies Austria GmbH, Turmstrasse 44, A-4031 Linz, Austria

[6]Magnetohydrodynamics Department, Helmholtz-Zentrum Dresden-Rossendorf, Bautzner Landstraße 400, D-01328 Dresden, Germany

Video S1 — Simulation results of the turbulent flow under the applied EMBr of 39 mT showing the distribution of the induced electric current, velocity field and the turbulent structures (defined by the iso-surface $Q_{\mathrm{crit}} = 100$). The flow is slightly rearranged under the magnetic field; however, no significant change is observed.

Video S2 — Simulation results of the turbulent flow under the applied EMBr of 156 mT showing the distribution of the induced electric current, velocity field and the turbulent structures (defined by the iso-surface $Q_{\mathrm{crit}} = 100$). The flow alternation is significant: turbulence is mostly damped; corresponding redistribution of the linear momentum causes acceleration of the meniscus.

Video S3 — Simulation results of the turbulent flow under the applied EMBr of 366 mT showing the distribution of the induced electric current, velocity field and the turbulent structures (defined by the iso-surface $Q_{\mathrm{crit}} = 100$). The flow pattern is dramatically changed: the meniscus is deaccelerated; two reverse flow zones are formed above and below the jets; an opposite vortex (OV) is initiated near the SEN port exit; OV develops in size and reaches meniscus, where starts to compete with the upper roll. The flow under the SEN transforms to the plug-type under the strong EMBr.

Video S4 — Simulation results of the turbulent flow under the applied EMBr of 441 mT showing the distribution of the induced electric current, velocity field and the turbulent structures (defined by the iso-surface $Q_{\mathrm{crit}} = 100$). The opposite vortex dominates and occupies the upper part of the mold. It is accompanied by strong reverse flow zones above and below the jets.