Characterising Through-Thickness Steel Microstructures Using Electromagnetic Sensors

LEI ZHOU[1], Fanfu Wu[1], Mohsen Jolfaei[1], John Hinton[2], Claire Davis[1]

[1]WMG, University of Warwick, United Kingdom, [1]Process, Primetals Technologies Ltd., United Kingdom

Enhanced monitoring techniques in steel production pave the way for advanced digitization and control, resulting in more energy-efficient manufacturing processes. Although significant advancements have been made in real-time monitoring of steel microstructures using electromagnetic (EM) sensors in strip steel production, these technologies have not been extended to other forms of steel processing. This study explores the application of EM sensors in plate steel mills, focusing on accelerated cooling post-rolling to achieve distinct microstructures for specific steel grades. The cooling process, regulated through variations in water flow rates and the number of cooling banks employed, produces through-thickness variations in the microstructure. Understanding the impact of these variations on EM sensor signals is critical for effective process control. In this paper, we examine the influence of through-thickness microstructural variations on EM sensor readings. We model the temperature and consequent microstructure distribution in a 25mm thick steel plate subjected to three different cooling rates (10, 20, and 30 °C/s). These data are then integrated into a finite element (FE) model to predict EM sensor responses. Experimental validation is carried out using a commercial EM sensor integrated into a furnace-run out table equipped with water cooling capabilities. The findings demonstrate the feasibility of employing EM sensors for real-time monitoring in plate steel mills.