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Numerical Investigation of Magneto-hydrodynamic Flow in an Aluminum Electrolysis Cell

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Abstract: The aluminium production process involves complex electrochemical reduction of alumina in an electrolysis cell. Magnetic field, flow pattern and thermal gradient of fluid in the cell, affect the overall cell behaviour. Current paper investigates the thermal profile and magneto-convective phenomena in the closed square duct by means of Computational Fluid Dynamics (CFD). The major goal is to present a base model for the simulation of flow pattern and thermal profile in a hypothetical simplified Hall-Heroult Aluminium reduction cell. The present model can be used as a base model for next advanced simulation in order to optimize key parameters. The simulation was investigated in three different amperages 300, 400 and 500 Ka. The results illustrated that by increasing the total current, the flow pattern is converted from laminar to turbulent. Thermal distribution also showed that the convective flow model is acceptable in this model. homogenization of the temperature in the cell was Increased by increasing magnetic field. In order to ensure the model validity, predicted values of the model compared with other research's and paper's results.

Keywords: Aluminium production; Hall-Heroult cell; Magneto-hydrodynamics; CFD