Validation of Anode Model for Voltage Drop Mitigation Studies

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Abstract

In aluminum smelters, the anode of a typical reduction cell has been widely reported as a location where significant amount of energy is wasted. These devices need optimization and a practical tool for this is the thermo-electro-mechanical (TEM) finite element model. In view of developing a computational tool fit for such optimization efforts, this study focuses on calibrating the contact stiffness factor (CSF) and on validating developed TEM models of the 4- and 8-flute anodes. Plant measurements of the anode stub to carbon (STC) and total (TVD) voltage drop, across the lifespan of the anode, were made for model validation. Calibration of the numerical model showed that CSF of 0.15 - 0.2 is adequate for the 8-flute anode while CSF of 0.5 is adequate for the 4-flute anode. Using these CSFs, results show that onsite measurements match the STC voltage drop and TVD, calculated by the TEM model. Overall, this article is an update on our finite element modeling of the aluminum-reduction cell anode.

Keywords: Aluminum reduction cell anode; anode model validation; anode voltage drop; contact stiffness factor.