Artificial neural network modeling and optimization of hall-heroult process for aluminum production

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Abstrak

Experience in applying a hybrid artificial neural network (ANN)-genetic algorithm for modeling and optimizing the Hall-Heroult process for aluminum extraction is described in this study. During the stage of modeling, the most important and effective process variables including temperature and cell voltage, metal and bath heights, purity of CaF2 and Al2O3, and bath ratio are chosen as input variables whilst outputs of the model are product purity, ampere efficiency, and product rate. During three years of operation, 19 points were selected for building and training, 7 points for testing, and 7 data points for validating the model. Results show that a feed-forward Artificial Neural Network (ANN) model with 3 neurons in the hidden layer can acceptably simulate the mentioned output variables with the Mean Squared Error (MSE) of 0.002%, 0.108% and 0.407%, respectively. Utilizing the validated model and multi-objective genetic algorithms, aluminum purity and the rate of production are maximized by manipulating decision variables. Results show that setting these decision variables at the optimal values can increase approximately the metal purity, ampere efficiency, and product rate by 0.007%, 0.185%, and 20kg/h, respectively.