Serbian Ceramic Society Conference
ADVANCED CERAMICS AND APPLICATION IX
New Frontiers in Multifunctional Material Science and Processing

Serbian Ceramic Society
Institute of Technical Sciences of SASA
Institute for Testing of Materials
Institute of Chemistry Technology and Metallurgy
Institute for Technology of Nuclear and Other Raw Mineral Materials

PROGRAM AND THE BOOK OF ABSTRACTS

Serbian Academy of Sciences and Arts, Knez Mihailova 35
Serbia, Belgrade, 20-21. September 2021.

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Application of Artificial Neural Networks in performance prediction of cement mortars with various mineral additives

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Prediction of physico-mechanical and thermo-mechanical properties of cement mortars with different mineral additives based on materials' starting compositions by means of machine learning models is an essential feature in contemporary civil engineering. In this study, the prediction of performances of seventeen mortar mixtures based on Portland cement (CEM I 42.5R) with mineral additives and subsequent comparison with properties of mortars in which various cement types were used as binders was conducted using artificial neural network (ANN) modeling. Analytical model comprised discrimination based on similarities and differences between composite mortars and mortars based on 6 different cement types (without additives). The employed cements were: ordinary Portland cement, moderate heat hydration cement, high early strength cement, low heath hydration cement, high sulphate resistant cement, calcium aluminate cement, and high alumina cement. The mineral additives used were: fly ash, bottom ash, zeolite, bentonite, perlite, vermiculite, pyrophyllite, micro silica, silica fume, spinel, chamotte, calcinated clay, kaoline clay, alumina, limestone, talc, and copper slag. This investigation designates the impacts of various process parameters, such as the concentration of SiO_2, Al_2O_3, Fe_2O_3, CaO, MgO, K_2O, Na_2O, TiO_2, SO_3, and LoI, and their effects on the quality of mortars with additives. The characteristics of mortars were evaluated regarding the dependent parameters such as: pozzolanic activity, heath of hydration, setting time, compressive strength, split tensile strength, compressive and split tensile strength under various temperatures up to 1000 °C, refractoriness, and sulphate resistence. Cluster Analysis and Principal Component Analysis were used for estimating the effect of ascertained process parameters on the quality of cements and additives. Artificial neural network model was employed to foresee the quality of cement mortars with additives of discovered outputs and its results show the high suitability level of anticipation: 0.999 during the training period, which can be regarded appropriately enough to correctly predict the observed outputs in a wide range of processing parameters. The developed ANN model displayed high predictive accuracy and it can be used in civil engineering for prediction of properties of novel mineral additives if their chemical composition is known.