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# Artificial Neural Network-Forecasted Compression Strength of Alkaline-Activated Slag Concretes

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**Abstract:** The utilization of ordinary Portland cement (OPC) in conventional concretes is synonymous with high carbon emissions. To remedy this, an environmentally friendly concrete, alkaline-activated slag concrete (AASC), where OPC is completely replaced by ground granulated blast-furnace slag (GGBFS) industrial waste, is one of the currently pursued research interests. AASC is not commonly used in the construction industry due to limitations in experience and knowledge on the mix proportions and mechanical properties. To circumvent great labour in the experimental works toward the determination of the optimal properties, this study, therefore, presents the compressive strength prediction of AASC by employing the back-propagation artificial neural network (ANN) modelling technique. To construct this model, a sufficiently equipped experimental databank was built from the literature covering varied mix proportion effects on the compressive strength of AASC. For this, four model variants with different input parameter considerations were examined and the ideal ANN architecture for each model with the best input number–hidden layer neuron number–output number format was identified to improve its prediction accuracy. From such a setting, the most accurate prediction model with the highest determination coefficient, $R^2$, of 0.9817 was determined, with an ANN architecture of 8-18-1 containing inputs such as GGBFS, a fine to total aggregate ratio, sodium silicate, sodium hydroxide, mixing water, silica modulus of activator, percentage of sodium oxide and water–binder ratio. The prediction accuracy of the optimal ANN model was then compared to existing ANN-based models, while the variable selection was compared to existing AASC models with other machine learning algorithms, due to limitations in the ANN-based model. To identify the parametric influence, the individual relative importance of each input variable was determined through a sensitivity analysis using the connection weight approach, whose results indicated that the silica modulus of the activator and sodium silicate greatly affected the AASC compressive strength. The proposed methodology demonstrates that the ANN-based model can predict the AASC compressive strength with a high accuracy and, consequently, aids in promoting the utilization of AASC in the construction industry as green concrete without performing destructive tests. This prediction model can also accelerate the use of AASC without using a cement binder in the concrete matrix, leading to produce a sustainable construction material.

**Keywords:** alkali-activated slag; concrete; artificial neural network; compression strength



**Citation:** Tang, Y.X.; Lee, Y.H.; Amran, M.; Fediuk, R.; Vatin, N.; Kueh, A.B.H.; Lee, Y.Y. Artificial Neural Network-Forecasted Compression Strength of Alkaline-Activated Slag Concretes. *Sustainability* **2022**, *14*, 5214. https://doi.org/10.3390/su14095214

Academic Editors: Saeed Reza Mohandes, Poorang Piroozfar, Sara Shirowzhan and Serdar Durdyev

Received: 23 January 2022
Accepted: 23 February 2022
Published: 26 April 2022