Evaluation of adaptive neuro-fuzzy inference system-genetic algorithm in the prediction and optimization of NOx emission in cement precalcining kiln

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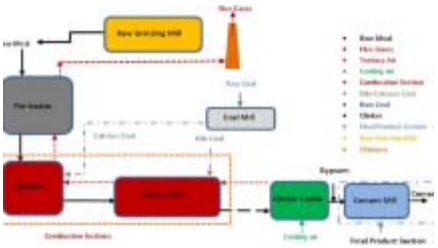
Abstract

The increasing demand for cement due to urbanization growth in Africa countries may result in an upsurge of pollutants associated with its production. One major air pollutant in cement production is nitrogen oxides (NOx) and reported to cause serious damage to human health and the ecosystem. The operation of a cement rotary kiln NOx emission was studied with plant data using the ASPEN Plus software. It is essential to understand the effects of calciner temperature, tertiary air pressure, fuel gas, raw feed material, and fan damper on NOx emissions from a precalcining kiln. In addition, the performance capability of adaptive neuro-fuzzy inference systems and genetic algorithms (ANFIS-GA) to predict and optimize NOx emissions from a precalcining cement kiln is evaluated. The simulation results were in good agreement with the experimental results, with root mean square error of 2.05, variance account (VAF) of 96.0%, average absolute deviation (AAE) of 0.4097, and correlation coefficient of 0.963. Further, the optimal NOx emission was 273.0 mg/m^3, with the parameters as determined by the algorithm were calciner temperature at 845 °C, tertiary air pressure − 4.50 mbar, fuel gas of 8550 m^3/h, raw feed material 200 t/h, and damper opening of 60%. Consequently, it is recommended that ANFIS should be combined with GA for effective prediction, and optimization of NOx emission in cement plants.



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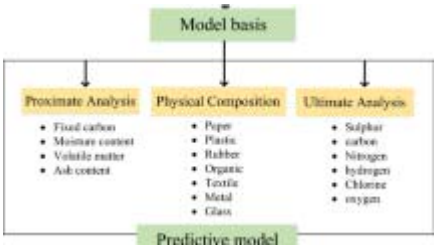

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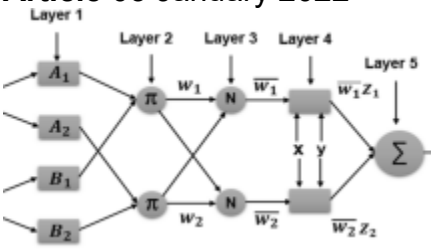

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Data availability

The datasets analyzed during the current study are available with the authors on reasonable request.

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Conceptualization, writing of the first draft preparation—Anthony I. Okoji; supervision and editing—Ambrose N. Anozie and James A. Omoleye; review, editing, simulation, and modeling—Abiola E. Taiwo; review and editing—Damilola E. Babatunde.

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Ethics declarations

Ethics approval

Not applicable.

Consent to participate

Informed consent was obtained from all individual participants included in the study.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Additional information

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