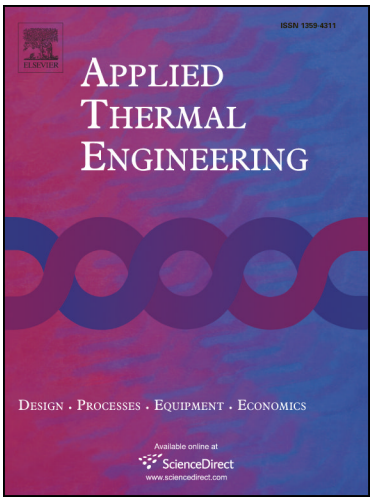

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Response surface optimization, modeling and uncertainty analysis of mass loss response of co-combustion of sewage sludge and water hyacinth

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Abstract

The present study aims at quantifying mass loss percentage (MLP, %) predictions and their stochastic uncertainty when co-combustion of sewage sludge (SS) and water hyacinth(WH) are applied as alternative biomass materials under different blend ratios (BR), heating rates (HR, ^{o}C/min) and temperatures (T, ^{o}C).Optimization and validation of experimental data through Box–Behnken design pointed to 630.9°C for T, 60.1% SS for BR, and 29.9°C/min for HR as the optimal co-combustion parameters to achieve the maximum MLP of92.4%. Monte Carlo (MC) simulations were used to quantify uncertainty in MLP predictions of the best-fit multiple non-linear regression (MNLR) model derived from the entire experimental data as a function of MC-generated T as the only continuous predictor of the MNLR. Mean MLP value of the MNLR predictions was higher by 19% than that of the MC-simulated T whose mean was higher by only 1% than mean measured T. Incorporating the uncertainty estimation based on Monte Carlo simulations with response surface approach for co-combustion of SS and WH was one of the main novel contributors of the present study to related literature.

Keywords: