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Uncertainty estimation approach in catalytic fast pyrolysis of rice husk: Thermal degradation, kinetic and thermodynamic parameters study

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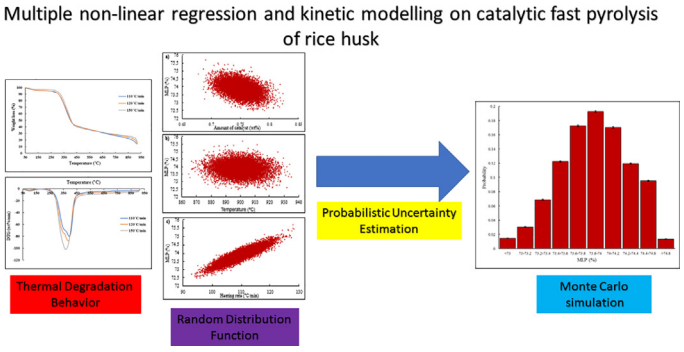
GRAPHICAL ABSTRACT



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ABSTRACT

The aim of this study was to understand the influence of catalyst in thermal degradation behavior of rice husk (RH) in catalytic fast pyrolysis (CFP) process. An iso-conversional Kissinger kinetic model was introduced into this study to understand the activation energy (E_A), pre-exponential value (A), Enthalpy (ΔH), Entropy (ΔS) and Gibb's energy (ΔG) of non-catalytic fast pyrolysis (NCFP) and CFP of RH. The study revealed that the addition of natural zeolite catalyst enhanced the rate of devolatilization and decomposition of RH associated with lowest E_A value (153.10 kJ/mol) compared to other NCFP and CFP using nickel catalyst. Lastly, an uncertainty estimation was applied on the best fit non-linear regression model (MNLR) to identify the explanatory variables. The finding showed that it had the highest probability to obtain 73.8–74.0% mass loss in CFP of rice husk using natural zeolite catalyst.

Abbreviations: RH, Rice husk; IEA, International Energy Agency; NCFP, non-catalytic fast pyrolysis; CFP, catalytic fast pyrolysis; TGA, Thermogravimetric analysis; DTG, difference thermogravimetry; E_A, activation energy; A, pre-exponential value; ΔH, Enthalpy; ΔS, Entropy; ΔG, Gibb's energy; MNLR, non-linear regression model; IEA, International Energy Agency; MC, moisture content; VM, volatile matter; FC, fixed carbon; AC, ash content; LHV, lower heating value; RH/N, thermal degradation of rice husk in catalytic fast pyrolysis using nickel as catalyst; RH/Z, thermal degradation of rice husk in catalytic fast pyrolysis using nature zeolite as catalyst; VIF, variation inflation factor; D-W, Durbin Watson factor; MC, Monte Carlo

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