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Step pyrolysis of N-rich industrial biowastes: regulatory mechanism of NO_x precursor formation via exploring decisive reaction pathways

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Abstract: Step pyrolysis of N-rich industrial biowastes was used to explore decisive reaction pathways and regulatory mechanisms of NO_x precursor formation. Three typical ones involving medium-density fiberboard waste (MFW), penicillin mycelia waste (PMW) and sewage sludge (SS) were employed to compare the formation characteristics of NO_x precursors during one-step and two-step pyrolysis. Results demonstrated that considerable NH_3-N predominated NO_x precursors for one-step pyrolysis at low temperatures, depending on primary pyrolysis of labile amide-N/inorganic-N in fuels. Meanwhile, NO_x precursors differed in the increment of each species yield while resembled in the total yield of 20-45 wt.% among three samples at high temperatures, due to specific prevailing reaction pathways linking with distinctive amide-N types. Subsequently, compared with one-step pyrolysis uniformly (800 °C), by manipulating intensities of reaction pathways at different stages (selecting differential intermediate feedstocks), two-step pyrolysis was capable of minimizing NO_x precursor-N yield by 36-43% with a greater impact on HCN-N (75-85%) than NH_3-N (9-37%), demonstrating its great capacity on regulating the formation of NO_x precursors for industrial biowaste pyrolysis. These observations were beneficial to develop effective insights into N-pollution emission control during their thermal reutilization.