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Mechanism of conditioner CaO on NO_x precursors evolution during sludge steam gasification

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Abstract

NH_3 and HCN are the predominant NO_x precursors generated from sludge steam gasification. CaO is a traditional chemical conditioner for sludge dewatering and it can also help control the emission of NO_x precursors when used as an additive in coal pyrolysis. This work investigated the influence of conditioner CaO on NO_x precursors evolution using an improved drop-tube/fixed-bed reactor at temperatures ranging from 873 K to 1273 K. An NH_3 decomposition experiment was conducted to further verify the mechanism underlying the effects of char. Results showed that by changing the compositions and proportions of volatile-N, conditioner CaO reduced HCN production by 9.9% and 5.3%, whereas increased NH_3 yield by 8.4% and 11.5% at 873 K and 1073 K, respectively. The hydrolysis of nitrile-N and HCN occurred readily in the gasification of volatiles in CaO conditioned sludge (named S-CaO). When char participated in the steam reforming of volatiles, S-CaO char showed good capacity for NH_3 decomposition at 1073 K. The final amount of NH_3 emissions was 11.3% lower than that of the gasification of raw sludge (named RS). CaO was able to catalyze the conversion of NH_3 to N_2, which can be promoted by steam. S-CaO ash was likely to oxidize NH_3 to NO. However, for S-CaO char, with the synergic effect of char carbon and conditioner CaO, NH_3 and NO were transformed into N_2 within a short time. This demonstrated that reusing conditioner CaO during sludge steam gasification at high temperatures is a promising technology for the control of NO_x precursors emissions.

Keywords: Sewage sludge; Conditioner CaO; NO_x precursors; Steam gasification

1. Introduction

Steam gasification is a promising technology for the conversion of solid fuel to H_2-rich gas, which may help meet the increasing demands for clean en-

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