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Full Length Article

Correlations between the sodium adsorption capacity and the thermal behavior of modified kaolinite during the combustion of Zhundong coal

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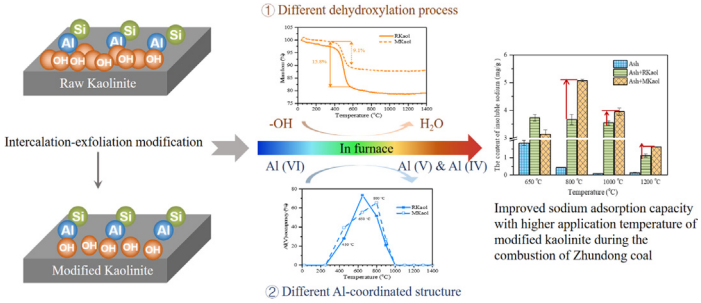
GRAPHICAL ABSTRACT



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ABSTRACT

Kaolin is often utilized as an additive to relieve fouling and slagging problems in boilers. In a previous work of the authors it was successfully employed the modification of intercalation-exfoliation method to improve the adsorption capacity of kaolinite at 1000 °C, and this work aimed to investigate the best adsorption performance and corresponding application temperature of modified kaolinite at different temperatures. The adsorption experiment with Zhundong coal was conducted from 650 °C to 1200 °C. The thermal behavior of modified kaolinite was characterized over a wide temperature range to reveal the mechanism from the perspective of structural change. Results showed that modified kaolinite exhibited the best adsorption performance at 800 °C, with the adsorption capacity increasing by 39% after modification. The effect of modification on kaolin was also reflected in the thermal behavior. About 43% of the hydroxyl groups were removed via modification, the amount of mullite above 1100 °C approximately decreased by 38%, and the expulsion of crystalline SiO_2 was totally inhibited by modification, suggesting that modification affected the reconstruction of Si/Al-related compounds at high temperature. In addition, the enhanced yield of unsaturated Al (V) at 800 °C after modification was totally consistent with the improved adsorption capacity of modified kaolinite at 800 °C. It is concluded that kaolinite can be used at higher temperature with improved adsorption capacity through a modification of intercalation-exfoliation method, which was presumably related to the greater content of 5-coordinated Al in modified kaolinite. Moreover, this discovery indicated that Al (V) content might be a useful index for the selection of various aluminasilicates as efficient adsorbents in furnace.

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