Structural Comparison of Sodium Bicarbonate and Hydrated Lime for Dry SO_2 Removal.

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Abstract

In dry flue gas treatment systems, gas-solid interactions are modulated by reagent molecular composition and physical attributes. In the present investigation, sodium and calcium-based sorbents were screened for structural and compositional variations for subsequent application in sulphur dioxide capture. Mined sodium bicarbonate ($NaHCO_3$) in unprocessed form and commercial grade hydrated lime ($Ca(OH)_2$) were subjected to morphological analysis employing scanning electron microscopy (SEM), particle size distribution (PSD), Brunauer-Emmett-Teller surface area evaluation and Barrett-Joyner-Halenda (BJH) pore structure classification. Fourier Transform Infrared Spectroscopy (FTIR) was leveraged for surface elemental chemical assessment. Pursuant to the BET report, $Ca(OH)_2$ presented a larger specific surface area (4.2360 m^2/g) as opposed to $NaHCO_3$ (0.2303 m^2/g), which was supported by the weighted mean value (D43) from the PSD analysis. Although $Ca(OH)_2$ had a higher pore volume (0.089822 cm^3/g), the totality of the $NaHCO_3$ pore size (117.312 Å) was classified as mesoporous. The SEM assessment suggests the lower $NaHCO_3$ surface area stems from larger particle sizes. The FTIR spectrum indicated a greater carbonate concentration in the $NaHCO_3$ sorbent material, which also architectures the pore morphology of the reagent. These findings offer critical information pertinent to the intricate dry flue gas desulphurisation process. The data generated will architect fixed bed experiments in a subsequent study.

Keywords: Calcium hydroxide, Emission mitigation, Sodium bicarbonate, Sulphation, Sorbent screening.

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