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An Experimental Study of Low Concentration CO_2 Capture from Regenerative Thermal Oxidation Tail Gas in Rotating Packed Bed

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Abstract : Carbon capture, utilization, and storage (CCUS) technology become a predominant technique to mitigate carbon dioxide and achieve net-zero emissions goals. This research targets to continuously capture the low concentration CO_2 from the tail gas of the regenerative thermal oxidizer (RTO) in the high technology industry. A rotating packed bed (RPB) reactor is investigated to capture the efficiency of CO_2 using a mixture of NaOH/Na_2CO_3 solutions to simulate the real absorbed solution. On a lab scale, semi-batch experiments of continuous gas flow and circulating absorbent solution are conducted to find the optimal parameters and are then examined in a continuous operation. In the semi-batch tests, the carbon capture efficiency and pH variation in the conditions of a low concentration CO_2 (about 1.13 vol%), the NaOH concentration of 1 wt% or 2 wt% mixed with 14 wt% Na_2CO_3, the rotating speed (600, 900, 1200 rpm), the gas-liquid ratio (100, 200, and 400), and the temperature of absorbent solution of 40 ºC are studied. The CO_2 capture efficiency significantly increases with higher rotating speed and smaller gas-liquid ratio, respectively, while the difference between the NaOH concentration of 1 wt% and 2 wt% is relatively small. The maximum capture efficiency is close to 80% in the conditions of the NaOH concentration of 1 wt%, the G/L ratio of 100, and the rotating speed of 1200 rpm within the first 5 minutes. Furthermore, the continuous operation based on similar conditions also demonstrates the steady efficiency of the carbon capture of around 80%.

Keywords : carbon dioxide capture, regenerative thermal oxidizer, rotating packed bed, sodium hydroxide
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