Enhanced CO_2 capture capacity of limestone by discontinuous addition of hydrogen chloride in carbonation at calcium looping conditions

Yingjie Li, Xiaotong Ma, Wenjing Wang, Changyun Chi, Jiewen Shi, Lunbo Duan

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Enhanced CO_2 capture capacity of limestone by discontinuous addition of hydrogen chloride in carbonation at calcium looping conditions

Yingjie Li[a]*, Xiaotong Ma[a], Wenjing Wang[a], Changyun Chi[a], Jiewen Shi[a], Lunbo Duan[b]

[a] School of Energy and Power Engineering, Shandong University, Jinan 250061, China

[b] Key Laboratory of Energy Thermal Conversion and Control of Ministry of Education, Southeast University, Nanjing 210096, China

Abstract: Calcium looping technology is considered to be one of the most feasible techniques for CO_2 capture. A low-cost and easy method was proposed to improve the cyclic CO_2 capture capacity of the limestone by discontinuously adding hydrogen chloride (HCl) in the carbonation step in some cycles rather than in the each cycle at the calcium looping conditions. The effects of the discontinuous addition of HCl under the various conditions on the CO_2 capture performance of the limestone at the calcium looping conditions were investigated in a dual fixed-bed reactor. The results show that HCl addition during the initial several cycles leads to the formation of CaClOH and the moderate CaClOH in the carbonation product is favorable to CO_2 capture by the limestone. HCl addition only in the initial 3 cycles changes the effect of carbonation temperature on CO_2 capture by the limestone. The optimum carbonation temperature for the limestone with the addition of HCl is 700 °C in the range of 650-750 °C. Higher CO_2 volume fraction in the carbonation leads to lower CO_2 capture capacity of the limestone with the addition of HCl only in the initial 3 cycles. The discontinuous addition of HCl during the various cycles significantly enhances the CO_2 capture capacity of the limestone. HCl addition in the carbonation stage during only the initial cycles improves the pore structure of the calcined limestone and retards the fusion of CaO grains, which contributes to high CO_2 capture capacity of the sorbent in the multiple cycles.

Key words: limestone; calcium looping; HCl addition; CO_2 capture

* Corresponding author: Tel.: +86-531-88392414; E-mail: liyj@sdu.edu.cn (Y. Li).