The Effects of Absorbent Temperature and Flue Gas Impurities on Carbon Dioxide Absorption in Carbonate Solutions

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Abstract

Capture of carbon dioxide (CO_2) from fossil fuel burning power plants is considered a logical target for mitigation of anthropogenic CO_2 emissions. Chemical absorption via carbonate solutions has been proposed as a possible CO_2 mitigation technology. Fossil fuel burning power plants present unique challenges to CO_2 capture, such as elevated flue gas temperatures (may lead to heating of the solution) and the presence of impurities (NO_x and SO_x) in the flue gas which may degrade the solution. Unlike the commercially available amine absorption technology, carbonate solutions may be able to act as a multi pollutant capture system. Carbonate solutions could serve as a cheap outlet for other impurities such as NO_x and SO_x which have their own dedicated, and costly, removal systems. In the present work, the absorption of CO_2 into a 2% (w/w) sodium carbonate solution was studied at solution temperatures from 25 ^oC to 60 ^oC and with gas streams containing a mixture of CO_2, NO_x, SO_x, and N_2. The goal of the study was to assess the potential/performance of carbonate solutions as a multi pollutant control technology at fossil fuel burning power plants. Studies found that when the solution temperature was increased from 25 ^oC to 60 ^oC, roughly a 50% decrease in the CO_2 absorption rate was seen. This implies that the solution should be kept as cool as possible for absorption. Absorption of carbon dioxide in the presence of NO_x and SO_x revealed a slight decrease in both the CO_2 absorption capacity of the solution and the rate of CO_2 absorption into the solution. However, these negatives were offset by the complete capture of all the NO_x and SO_x that was fed to the solution. Current studies suggest sodium carbonate solutions possess the potential to serve as a multi pollutant capture technology at fossil fuel burning power plants.