A SYNTHETIC STABILISER FOR CALCIUM-BASED SORBENTS FOR USE IN CO_2 LOOPING

D. S. Sultan, W. Liu, O. Nikiforova, S. Pstrokonski, J. S. Dennis
dss41@cam.ac.uk
Department of Chemical Engineering and Biotechnology, University of Cambridge, Pembroke Street, Cambridge CB2 3RA, United Kingdom

Coal is used for around 39% of the global production of electricity. Despite being one of the most polluting fossil fuels, in terms of mass of CO_2 emitted per unit of power generated, the use of coal globally is projected to increase from present day levels by ~ 80% by 2030. It is, therefore, imperative to find ways of using it for power generation whilst reducing the release of CO_2 into the atmosphere. One possibility would be to capture the CO_2 released from the flue gas of coal-fired power plants and, subsequently, to release it as a pure stream for sequestration, using calcium-based sorbents in a carbonation-calcination looping process.
Naturally-occurring candidates for this process, such as limestone, undergo a fall in their capacity to absorb CO_2 with repeated looping cycles of carbonation and calcination [1][2]. Work has been conducted [3] on the longer-term stability of synthetic sorbents containing inert components. One such stabiliser is $MgAl_2O_4$ spinel and, following previous work [4], alternative methods, involving co-precipitation and hydrolysis, have been developed to produce a CaO-based sorbent containing it.
The resulting CaO-$MgAl_2O_4$ sorbents have been tested in both a fluidised bed and a thermogravimetric analyser. One sorbent has been found to increase its uptake of CO_2 with cycling, while another has maintained a very high level of uptake, over the course of 100 cycles. An increase in the molar concentration of CO_2 in the carbonating gas has also given an increase in CO_2 uptake. These trends are accompanied by a corresponding increase in the volume of pores measured in the BJH (diameter < 200 nm) region.

References

[1] Abanades, J.C., Anthony, E.J., Lu, D.Y., Salvador, C., Alvarez, D., "Capture of CO_2 from combustion gases in a fluidized bed of CaO", *AIChE J.* 50: 1614-1622 (2004).
[2] Sun, P., Grace, J., Lim, C, Anthony, E., "The effect of CaO sintering on cyclic CO_2 capture in energy systems", *AIChE J.* 53: 2432-2442 (2007).
[3] Sultan, D.S., Müller, C.R., Dennis, J.S., "Capture of CO_2 Using Sorbents of Calcium Magnesium Acetate (CMA)", *Energy Fuels* 24: 3687-3697 (2010).
[4] Li, L., King, D.L., Nie, Z., Li, X.S., Howard, C., "$MgAl_2O_4$ Spinel-Stabilised Calcium Oxide Absorbents with Improved Durability for High-Temperature CO_2 Capture", *Energy Fuels* 24: 3698-3703 (2010).