Influence of humidity on CO_2 solid sorbent performance: insight and challenges

Paul IACOMI

[1]*Surface Measurement Systems, London, UK*

Solid sorbents are one of the most promising candidates for the implementation of direct air capture (DAC) solutions for scrubbing CO_2 out of the ambient air. Bringing a promising material from the lab to industry requires a realistic screening of its performance in process relevant conditions. The main goal from a materials standpoint is identifying and screening sorbents with the necessary affinity at the low (400 ppm) CO_2 concentration, long term usability, and thermal properties [1].

One of the most pertinent challenges relies in the presence of humidity in the air, leading to several possible effects on a material's CO_2 capture potential. Water molecules compete with CO_2 for sorption sites in many materials (zeolites and most MOFs). In others the presence of a certain amount of humidity can increase total amount adsorbed, or speed up the sorption kinetics, as in the case of amine-based materials[2] and alkali or alkaline earth metal carbonation processes[3]. Even in non-interacting scenarios, the coadsorption of water at high humidity levels leads to higher energy requirements during the regeneration since besides CO_2 also water must be desorbed.

Therefore, assessing the influence of moisture on the CO_2, and the amount taken up of each from a multicomponent mixture, is of crucial importance. In this presentation we will explore several methods of accomplishing this difficult task, and then walk through several examples on prototypical materials.

[1] M.-Y. (Ashlyn) Low, L. V. Barton, R. Pini, C. Petit, *Chem. Eng. Res. Des.* **2023**, *189*, 745–767.
[2] T. Wang, K. S. Lackner, A. Wright, *Environ. Sci. Technol.* **2011**, *45*, 6670–6675.
[3] P. López-Arce, L. S. Gómez-Villalba, S. Martínez-Ramírez, M. Álvarez De Buergo, R. Fort, *Powder Technol.* **2011**, *205*, 263–269.