ESTIMATION OF DIFFUSION TIME CONSTANTS FOR CO_2 ADSORPTION ON MICROPOROUS MATERIALS

S.I. Garcés[(1)], J. Villarroel-Rocha[(2)], K. Sapag[(2)], S.A. Korili[(1)], A. Gil[(1)] *

[(1)] Departamento de Química Aplicada, Universidad Pública de Navarra, Pamplona, ESPAÑA
[(2)] Laboratorio de Sólidos Porosos, INFAP-CONICET, Universidad Nacional de San Luis, ARGENTINA

*andoni@unavarra.es

ABSTRACT

In this work adsorption rates, uptake-curves, of CO_2 on two commercial zeolites (5A and 13X), a commercial MOF (ZIF-8) and a pillared clay (Zr-PILC) [1] were measured volumetrically at 273 K and gas pressure up to 800 mmHg. The diffusion time constants were calculated using the isothermal and non-isothermal models [2] in order to evaluate the heat effects. The results found were discussed from the pore size distribution and the strength of the interaction of CO_2 with the adsorbent, evaluated from the Henry's Law constants. The pressure-dependence of the diffusion time constants was predicted with the Darken-relation, structural [3], and supercritical-structural [4] diffusion models combined with several isotherm models. All materials presented a fast sorption rate of CO_2 and the isothermal models were unable to describe the experimental uptake curves. Therefore, the reliable diffusion time constants were obtained from the heats effects and this constant increased with the pressure and the pore size. The zeolites presented the slow diffusion time constants due to the small pore size and the very strong adsorption with CO_2.

Keywords: Diffusion time constant, sorption rate.

References

[1] Gil, A.; Korili, S.A.; Vicente, M.A. 1 .Recent advances in the control and characterization of the porous structure of pillared clay catalysts, Catal. Rev.-Sci. Technol., 50, (2008), 153–221.
[2] Ruthven, D.M. Principles of Adsorption and Adsorption Processes, Jhon Wiley & Sons, New York, (1984).
[3] Do, DD. A model for surface diffusion of ethane and propane in activated carbon, Chem Eng Sci, 51, (1996), 4145–58.
[4] Bae, Y.-S.; Lee, C.-H. Sorption kinetics of eight gases on a carbon molecular sieve at elevated pressure, Carbon, 43, (2005), 95–107.