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Diffusion of CO_2 in ion-exchanged zeolites Rho studied by the ZLC technique

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Here we present the use of the ZLC technique to investigate the diffusion of CO_2 in different Ion-exchanged Zeolites Rho samples. The sample were synthesized at the University of St. Andrews and tested at the University of Edinburgh using the ZLC method as part of the Innovative Gas Separations for Carbon Capture (IGSCC) project.

The ZLC technique, first introduced for diffusion measurements in zeolites, has been continuously developed proving its validity in the investigation of the kinetic and equilibrium properties in solid adsorbents. The very small size of the column offers several key advantages compared to other experimental methods: foremost, the small required sample quantity (1–2 mg for kinetic measurements to 10–15 mg for equilibrium measurements) greatly reduces the synthesis costs of the materials and allows rapid testing of prototype materials. The small size of the column reduces the complexity of the analysis methods because heat and external mass transfer resistances are negligible and axial dispersion is maximised achieving a uniform external concentration. The dynamic response of the ZLC can be interpreted easily.

In this study we have extended the use of the ZLC to very slow diffusional time constants by reducing the gas flowrates to less than 3 cc/min. When very slow kinetics are measured it is very difficult to extract the diffusivities from the traditional long time asymptotic analysis. We will show how the combination of the full saturation and partial loading experiment can provide un-ambiguous diffusional time constants. The results for the diffusivity of CO_2 in zeolite Rho samples will be shown to be strongly influenced by the framework structure as well as the nature and the position of the different cations in the framework.

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