A study of the solubility and diffusion kinetics of CO$_2$ in a polyimide film at various temperatures

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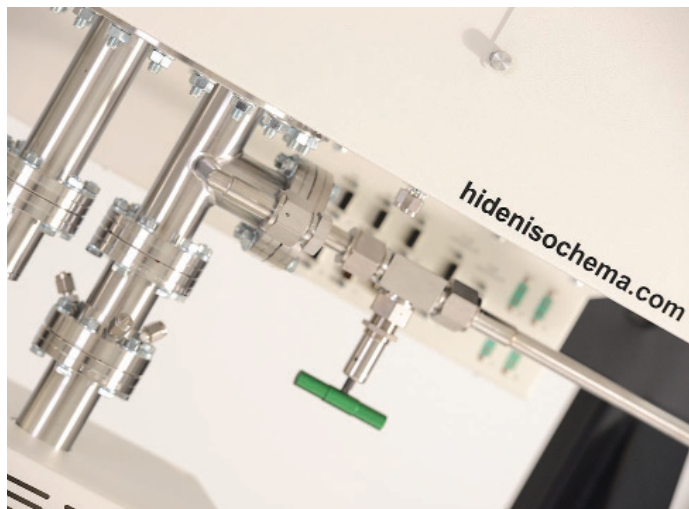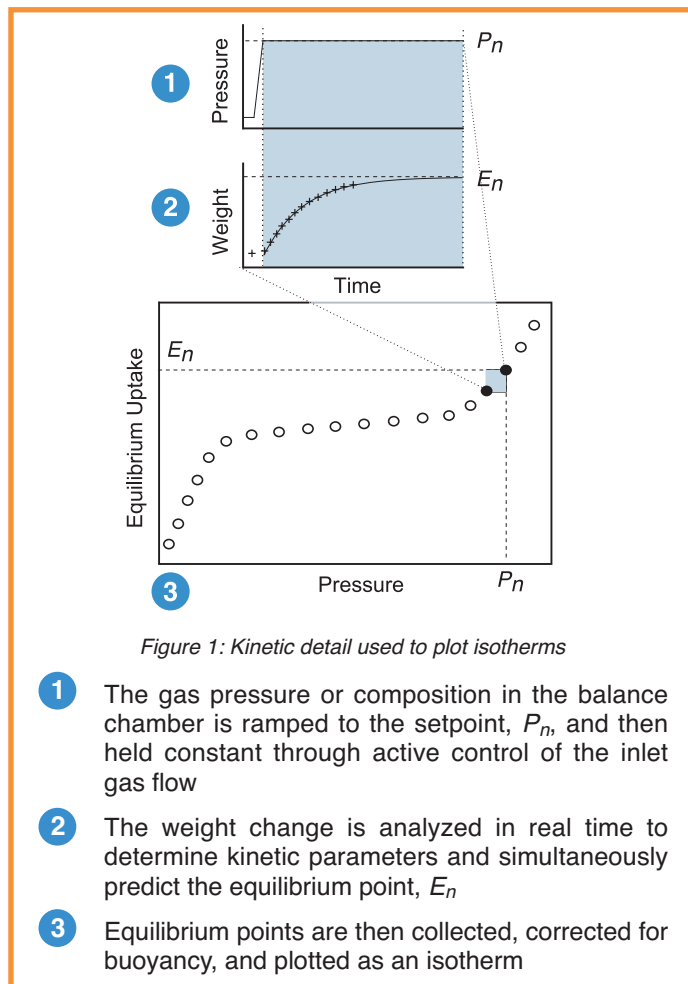
Introduction

A small piece of the film was directly loaded into the IGA-001 system. It was outgassed to high vacuum (<10-6mb) at a temperature of 60 °C.

The sample was then studied isothermally at 20 °C, 35 °C and 60°C by stepping up the pressure to measure the adsorption branch then stepping down the pressure to measure the desorption branch using CO$_2$ as the sorbate.

The IGA method described in Figure 1 was utilised to fit to the weight relaxation resulting from each of the pressure steps. The F1 model was utilised during this experiment.

The IGA method predicts the point of equilibrium uptake from the fit and determines the rate constant of the adsorption k (k=1 / time constant), it also ensures that each point on the isotherm
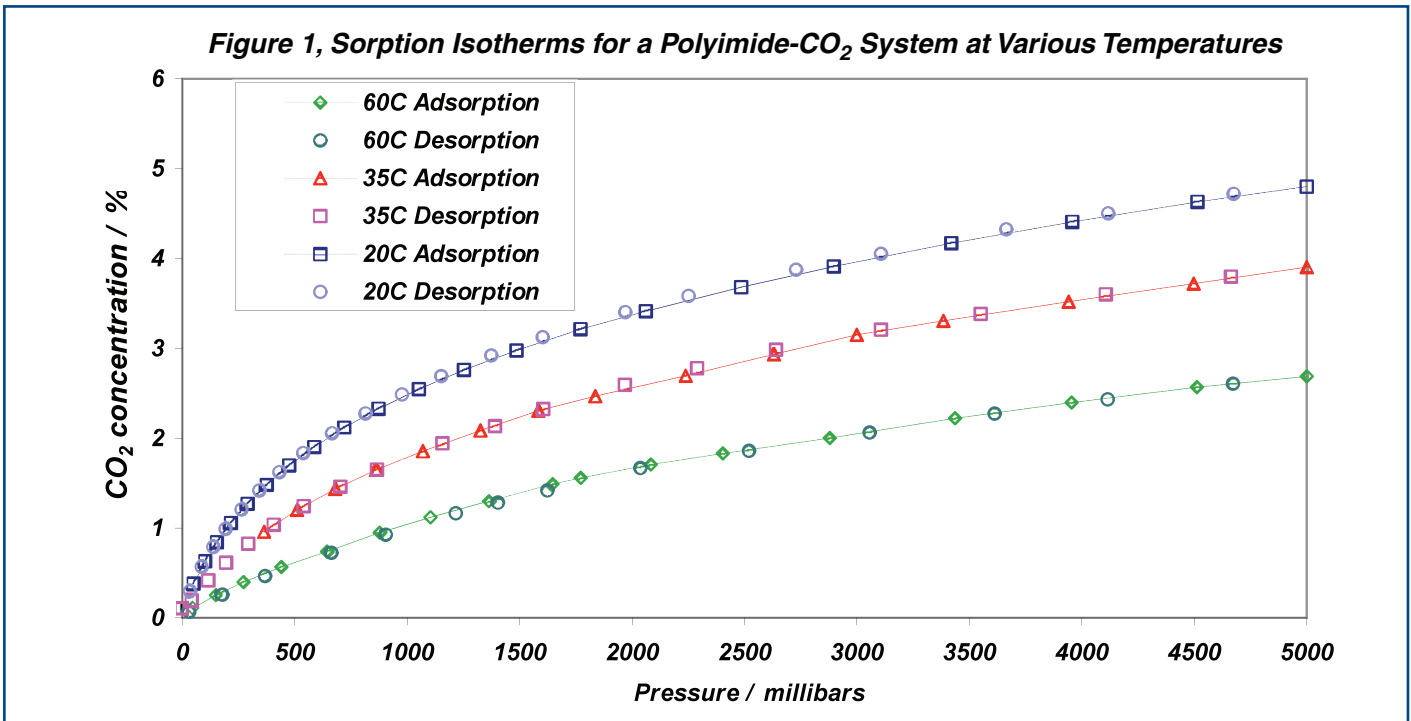

Figure 1: Kinetic detail used to plot isotherms

1 The gas pressure or composition in the balance chamber is ramped to the setpoint, P_n, and then held constant through active control of the inlet gas flow

2 The weight change is analyzed in real time to determine kinetic parameters and simultaneously predict the equilibrium point, E_n

3 Equilibrium points are then collected, corrected for buoyancy, and plotted as an isotherm

Figure 1, Sorption Isotherms for a Polyimide-CO_2 System at Various Temperatures

Figure 2 displays the CO_2 adsorption isotherms measured at 20 °C, 35 °C and 60 °C on the film sample

Figure 2, Variation of Expotential Time Constant with CO_2 Concentration for a Polyimide-CO_2 System
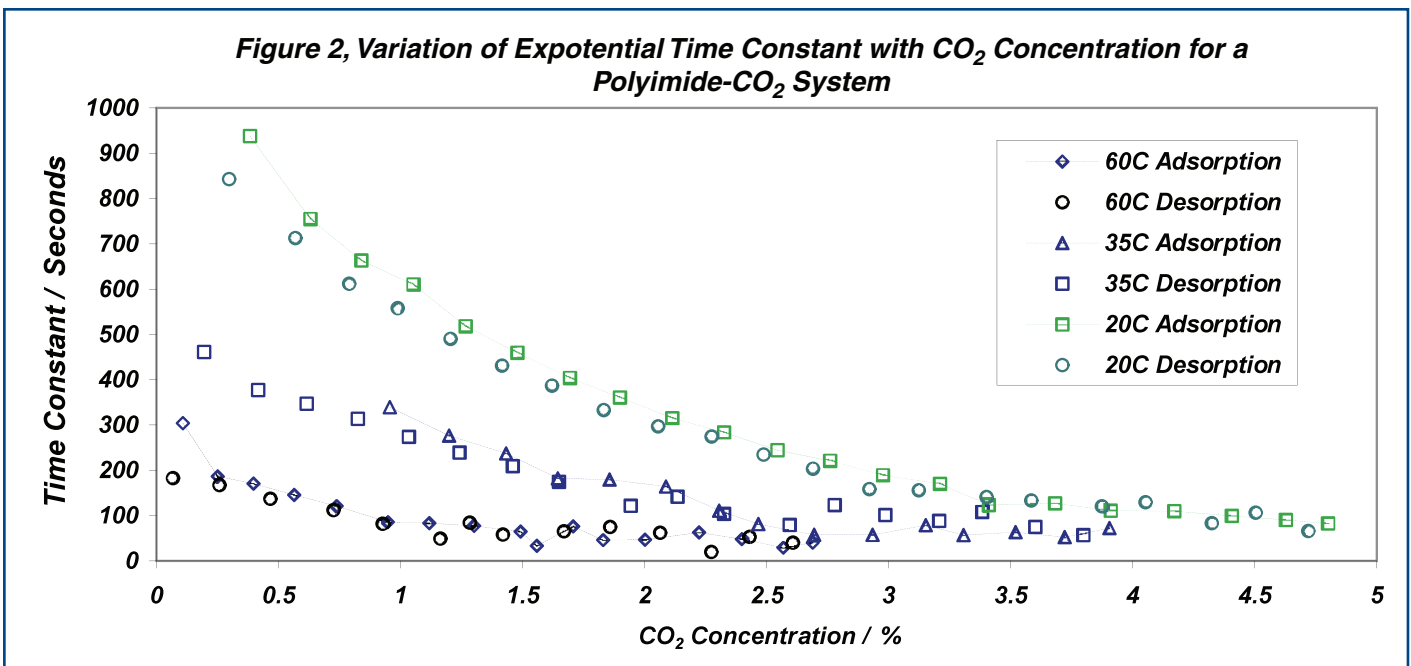

Figure 3 displays the time constants measured for each isotherm point shown in figure 1.

is measured to the same accuracy and optimizes the use of instrument time.

Permeability depends on both the concentration and diffusion constants (which can be calculated from rate or time constants)

the IGA is the perfect tool to investigate these factors independently.

See also application article 117 for more information about the determination of diffusivity and permeability.