ANALYZER
HIDEN ISOCHEMA NEWSLETTER
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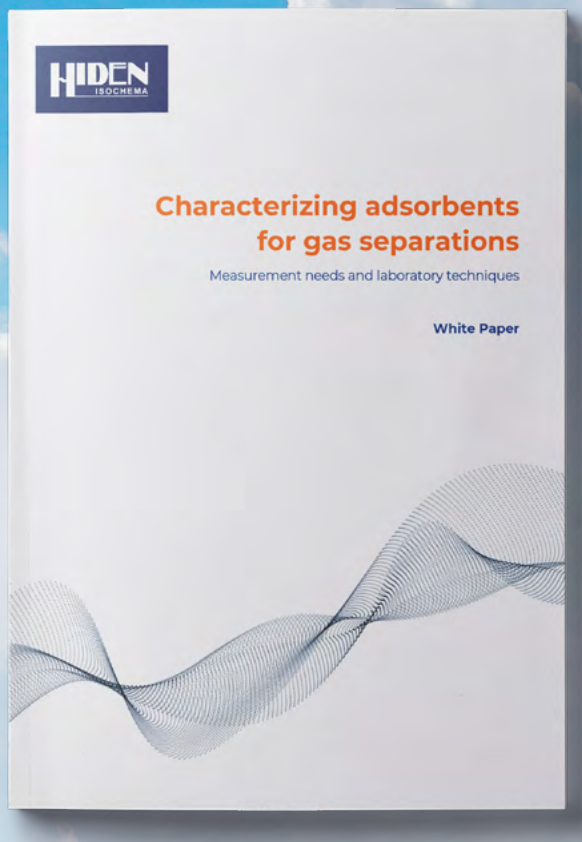
HIDEN ISOCHEMA

A breath of fresh air

How porous materials can purify and separate gases



Porous materials are widely used to separate and purify gases, but the field continues to expand as interest in using adsorption as an energy-efficient separation method grows.

In this newsletter we focus on gas separation, as we review our new white paper on the topic; look at the selective adsorption of ethyl acetate by a porous macrocycle molecule; share the University of Manchester's recent exhibit on using MOFs to capture toxic air pollutants; and highlight how our IGA instrument is playing a key role in investigating the drying of natural gas using zeolites in Brazil.

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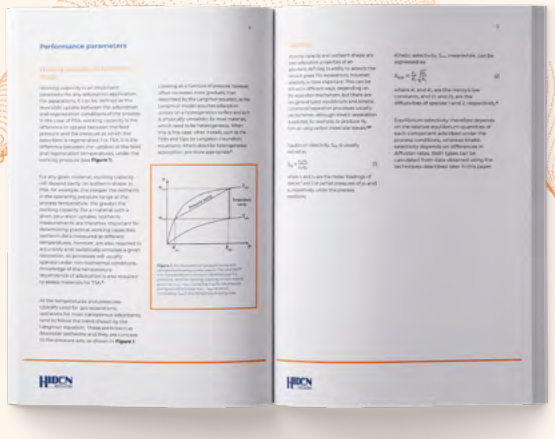
NEW WHITE PAPER

Characterizing Adsorbents for Gas Separations



Porous adsorbents such as zeolites and activated carbons are widely used in industrial gas separations. In order to select a material for a given separation, and to subsequently design and optimize a process, each adsorbent must be thoroughly characterized. Although commercial instruments are widely available for this purpose, gas adsorption, particularly at higher pressures, can be challenging to measure accurately.

Our new white paper introduces the information required to characterize the performance of adsorbents for gas separations and describes the main measurement techniques, together with some of the measurement pitfalls. The aim is to provide useful, practical information for anyone interested in characterizing adsorbents for gas separations.

Download the free white paper from our website: www.hidenisochema.com

Measuring ethyl acetate vapor sorption selectivity in porous materials

Hiden Isochema scientists recently co-authored a paper, published in Chemistry – A European Journal, reporting the selective adsorption of ethyl acetate by a porous macrocycle molecule.

The study, led by Professor Andy Cooper and Dr. Ming Liu at the University of Liverpool, also included contributions from the University of Southampton and East China University of Science and Technology.

Ethyl acetate is widely used as a solvent in the chemical industry and is primarily synthesized from ethanol. Separation of the product ethyl acetate from ethanol is challenging and energetically demanding, as the boiling points of the two species are very close. Adsorption-based separation of ethyl acetate from ethanol using microporous materials is therefore an interesting and industrially relevant research area.

The study reports the synthesis and structural analysis of an ethyl acetate solvent templated trianglimine macrocycle (TAMC), and the macrocycle's ethyl acetate and ethanol vapor phase adsorption behavior. Vapor phase adsorption isotherms, kinetics and cyclic adsorption-desorption measurements were measured using an IGA-002 gravimetric sorption analyzer and breakthrough measurements recorded using an ABR automated breakthrough analyzer.

Reference:
Inherent Ethyl Acetate Selectivity in a Trianglimine Molecular Solid
D. He, C. Zhao, L, Chen, M. A. little, S. Y. Chong, R. Clowes, K. McKie, M. G. Roper G. M. Day, M. Liu and A. I. Cooper, Chemistry - A European Journal, 2021, 27, 10589-10594.

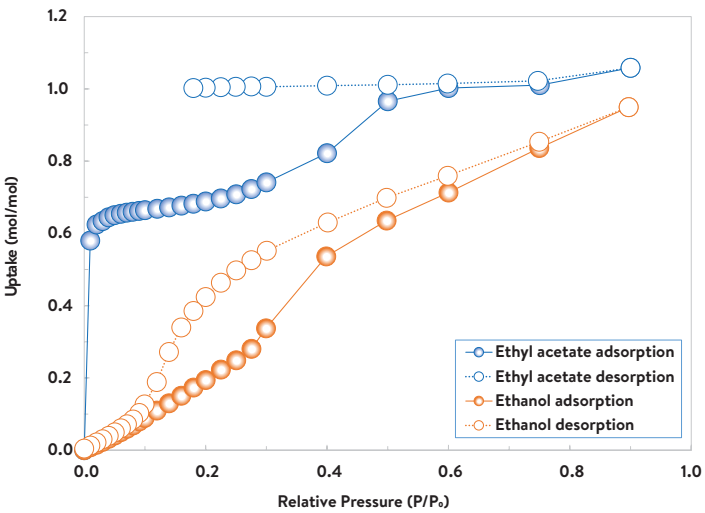


Figure 1. Ethanol (P_0 = 7.95 kPa) and ethyl acetate (P_0 = 13.33 kPa) vapor sorption isotherms on **α-TAMC** at 298 K

"The data from Hiden Isochema's gravimetric sorption and breakthrough analyzers provided us with conclusive experimental evidence regarding the high selectivity of our material."

Dr. Ming Liu,
University of Liverpool, UK

Will we breathe fresh air again?

MANCHESTER 1824
The University of Manchester

Hiden Isochema was delighted to be invited to support the University of Manchester with their exhibit 'Will we breathe fresh air again?' which was selected for the prestigious Royal Society's 2021 Summer Science Exhibition.

Each year, the organizers invite a number of cutting-edge research projects to bring their work to life through interactive quizzes, games and videos. The theme of the event was 'advanced materials applied to environmental pollution and sustainability'. The all-digital format this year attracted a global audience of all ages, who were able to meet the experts behind leading science research in the UK.

The research project from the University of Manchester, one of Hiden Isochema's long-standing customers, was focused on their novel functional materials for capture of toxic air pollutants for clean air. It was an opportunity for the Manchester Framework Materials group, led by Prof. Martin Schröder, to highlight their research to a wider audience and for general outreach work on behalf of the porous materials community.

The Schröder group use Hiden Isochema's **XEMIS**, **IGA** and **ABR** analyzers to measure the ability of their framework materials to reversibly and selectively adsorb toxic gas species from air, which is an essential step towards their potential use to mitigate atmospheric pollution.

"Many of our significant advancements in this field have benefitted greatly from the use of Hiden Isochema instrumentation."

Dr Gemma Smith, Research Associate, Department of Chemistry, University of Manchester, UK

We'd like to congratulate the team on an excellent and engaging exhibit which brilliantly demonstrates the scientific principles of their research via hands-on interactive games and inspiring talks.

Find out more at www.royalsociety.org/summer-science

Founded in November 1660 by King Charles II, the Royal Society is the oldest national scientific institution in the world.

Previous Fellows include scientists as notable as Isaac Newton, Charles Darwin, Albert Einstein, Dorothy Hodgkin and Stephen Hawking. Current Fellows include Jocelyn Bell Burnell, Elon Musk, Tim Berners-Lee and the 2021 Nobel Prize winner David MacMillan.

The Society allocates nearly £42 million each year from government grants, donations and legacies from organizations and individuals. Through policy work, journals, scientific meetings, events, worldwide partnerships, and grants and awards, the Royal Society works to support excellence in science, building a home and future for science in the UK.

THE ROYAL SOCIETY

The story of modern science

Drying natural gas in Brazil

It was a pleasure for Hiden Isochema to support and present at last year's Brazilian Adsorption Meeting. One of the papers published in the proceedings of the conference included interesting IGA data related to the drying of natural gas using zeolites.

Natural gas is an increasingly important energy resource in Brazil, one of the countries in which natural gas is commonly used, for example, as a fuel for road vehicles. A key aspect of natural gas processing is the removal of water, particularly to avoid gas hydrate formation that can lead to blocked pipelines. Different separation methods can be used, but temperature swing adsorption (TSA) using zeolites is a popular choice, as very low water concentrations can be achieved using this method. Due to the temperature swing conditions, and the presence of water and higher hydrocarbons, deactivation of the materials is a common problem. Such deactivation results from processes such as hydrothermal decomposition and coke formation.

In light of this, Professor Diana Azevedo and co-workers, from Universidade Federal do Ceará in Fortaleza, used an **IGA-002** to investigate water adsorption by two industrial adsorbents, both before and after accelerated aging, performed using a protocol designed to mimic deactivation in a real TSA process. The aging process for two different zeolites – 4A and a natural chabazite – significantly reduced both equilibrium capacity and the rate of water diffusion, as determined by measuring isobaric water adsorption kinetics for both samples. However, the 4A zeolite was found to be far more susceptible than the natural chabazite to hydrothermal deactivation.

This study is an excellent example of the use of gravimetrically determined vapor adsorption data, to obtain additional information about a sample. It also nicely illustrates how **IGA** data can be applied to problems of industrial importance.

Reference:

Water adsorption in fresh and thermally aged zeolites: equilibrium and kinetics
B. O. Nascimento, B. F. dos Santos, D. A. S. Maia, D. C. de Melo, E. Vilarrasa-Garcia, A. E. B. Torres, M. Bastos-Neto and D. C. S. Azevedo - Adsorption, 2021, 27, 1043–1053

Thank you 1k followers

Thank you to our Twitter followers for their continued support in helping to grow our social media platforms. We've reached the 1k milestone!

We will continue to Tweet company news, research, materials science and anything else we find interesting. If you're not already following us, you can find us on Twitter at **@HidenIsochema**

PUBLICATION ROUND-UP

Porous Ionic Liquids

High-Performance Porous Ionic Liquids for Low Pressure CO_2 Capture

J. Avila, L. F. Lepre, C. C. Santini, M. Tiano, S. Denis-Quanquin, K. C. Szeto, A. A. H. Padua, and M. Costa Gomes

Angewandte Chemie International Edition, 2021, 63, 12876-12882

Porous ionic liquids, with properties of both ionic liquids and porous solids, are an exciting class of material with potential applications related to gas storage, gas separation and catalysis. Researchers from the Université de Lyon, France, prepared new porous ionic liquids by dissolving the MOF ZIF-8 in mixtures of phosphonium based ionic liquids. Gas solubility measurements using an **IGA-001** showed that the porous ionic liquids reversibly captured large quantities of carbon dioxide at pressures close to ambient. The results are discussed in terms of the sizes of the ionic liquid cations and anions, and potential reaction products, with respect to the pores of the MOF.

Fuel Cell Membranes

Humidity-Induced Mechanical Behavior and Proton Transport Mechanism in Aromatic Multiblock Ionomer Membranes

E. Planes, H.-D. Nguyen, T. K. L. Nguyen, N. Charvin, L. Flandin, S. Lyonnard and C. Iojoiu

ACS Applied Energy Materials, 2021, 4, 5809–5820

Researchers at Université Savoie Mont Blanc, France, evaluate the water vapor sorption and diffusion, and electrical conductivity properties of novel aromatic multiblock ionomer membranes. These materials show potential as a high efficiency alternative to conventional Nafion membranes in proton-exchange membrane fuel cells. An **IGAsorp-CT** was used to measure water vapor isotherms for Nafion and the novel membranes at various temperature and humidity conditions up to 70 °C and 90 %RH. Isotherms were fitted to a dual-mode sorption model, and the kinetics used to determine diffusion coefficients for each isotherm point.

Hiden Isochema Limited
422 Europa Boulevard, Warrington WA5 7TS
Tel: +44 (0) 1925 244 678 Email: info@hidenischema.com

hidenisochema.com