VAMAS

Solid Sorbents
Technical Working Area 39

Project 2

Water Vapor Sorption Isotherms on Nanoporous Carbon

BACKGROUND

The ubiquitous nature of water makes understanding its effects on the chemical structure and properties of materials important to the development, processing, and applications of materials associated with food production, pharmaceuticals, construction, separation processes, sorbent-based industries, and emerging water sorption applications such as water harvesting and thermal energy storage.

A primary way to characterize water and materials interactions is by measuring a water vapor sorption isotherm, which determines the amount of water adsorbed as a function of relative pressure (P/P_0) for pure water measurements or relative humidity (RH), when water is entrained in another gas. With the large number of isotherms generated by automated instrumentation, there is an increasing need for standardized measurement protocols, reference materials, and reference data to ensure reliable and reproducible data. To address these needs, an international, interlaboratory study (ILS), was coordinated by the Facility for Adsorbent Characterization and Testing (FACT Lab) based at the National Institute of Standard and Technology (NIST).

WORK PROGRAMME

Participants were asked to measure water vapor sorption on a pelletized, high surface area nanoporous carbon at 25 °C as a function of P/P_0 for pure water or RH.

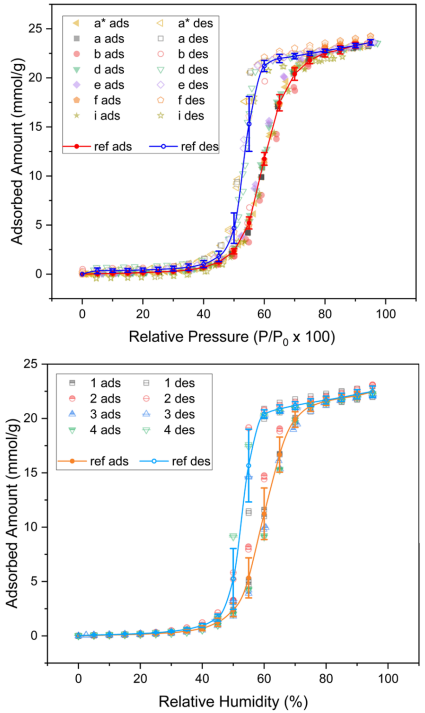
BAM-P109

BAM (Bundesanstalt für Materialforschung und prüfung) generously donated the nanoporous carbon (BAM-P109, a certified reference material), and NIST provided the protocol for the ILS. Thirteen laboratories participated in the study and contributed nine pure water vapor isotherms and four relative humidity isotherms, using nitrogen as the carrier gas. From these datasets, reference isotherms, along with the 95% uncertainty interval, were determined.

Summary of Results

REFERENCE ISOTHERMS

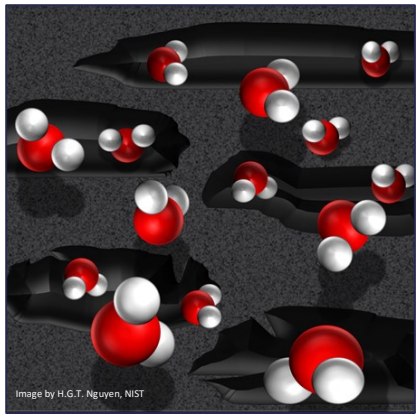
A variety of statistical tests were used to evaluate the submitted isotherms, in order to detect outliers. These outliers were removed from further evaluation and a reference isotherm was extracted from the remaining datasets. These datasets and reference isotherm, along with the associated confidence interval, are shown below.



Datasets and reference isotherms

DISSEMINATION

The datasets and reference isotherms are available in a peer-reviewed journal article[1] and will also be available through the NIST/ARPA•E Database of Novel and Emerging Adsorbent Materials.[2]



H_2O on nanoporous carbon

REFERENCES

[1] H.G.T. Nguyen *et al. Adsorption*, accepted (2023).

[2] https://adsorption.nist.gov

For more information:

Dr. Huong Giang T. Nguyen
Chair, VAMAS TWA 39
Facility for Adsorbent Characterization & Testing - NIST, USA
huong.nguyen@nist.gov

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www.vamas.org