Porous Materials, Inc.

Pharmaceuticals

Chemicals

Automotive

Ceramics

Filters

Papers

Not just products... Solutions !

SORPTOMETER
BET-201-A

Sorptometers

PMI's BET-Sorptometer is fully automated, volumetric gas sorption analyzer to measure accurately adsorption and desorption isotherms for the characterization of surface area, pore size distribution, pore volume and pore structure of micro and mesoporous materials as well as the kinetics of adsorption.

Sorptometers Principle

When clean surface is exposed to a gas, an adsorbed film forms on the surface. Adsorbed films also form on the surface of pores within a material and vapor can condense in the pores. At a constant temperature, the amount of adsorbed/condensed gas on a surface depends on the pressure of the gas. Measurement of the amount of adsorption/condensation as a function of pressure can give information on the pore structure. The PMI Sorptometers use gas adsorption/condensation to analyze pore characteristics. Further, measurement of pressure as a function of time provides the kinetics information of adsorption.

Adsorption & Desorption Isotherm

Adsorption and desorption of gasses on samples can be accurately measured using our BET Sorptometer. The user has independent control over the quantity and spacing of pressures used in both adsorption and desorption testing. Many different kinds of analyses are available to interpret data using the supplied report generation software.

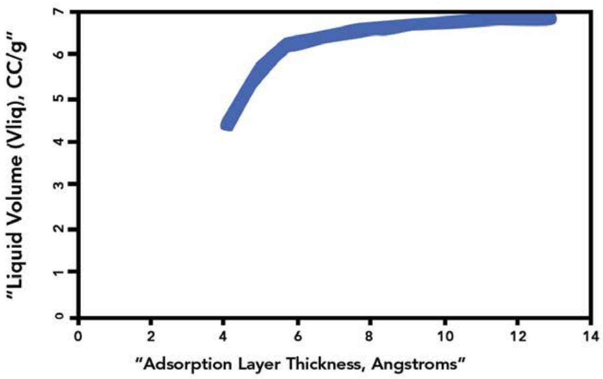


Fig.1 T - Plot Method - Micropore Volume Analysis

Physical Adsorption

Weak van der Waal's type interaction of molecules with a pore surface leads to physical adsorption. The Brunauer, Emmett and Teller (BET) theory of physical adsorption is normally used for analysis of adsorption data to compute surface area.

$$\frac{P}{W(P_0\text{-}P)} = \frac{1}{CW_m} \quad \frac{C-1}{CW_m} \quad \frac{P}{P_0}$$

Where:

W = amount of adsorbed gas

W_m = amount of gas adsorbed in a monolayer

P = gas pressure

P_0 = equilibrium (saturation) vapor pressure at the test temperature

C = dimensionless constant that depends on the temperature and the gas/solid system

When vapor pressure, P is low compared with P_0 ($0.05 < P/P_0 < 0.3$), the plot of $[P/W\ (P_0 - P)]$ verses $[P/P_0]$ is linear and the plot yields the magnitudes of C and Wm. The surface area S per unit mass, m, of the sample is computed using the cross-sectional area of the adsorbed gas molecule:

$$S = \frac{W_m N_o\ a}{m}$$

Where:

N_o = Avogadro's number

a = cross-sectional area of the adsorbed gas molecule

W_m = amount of gas adsorbed in moles

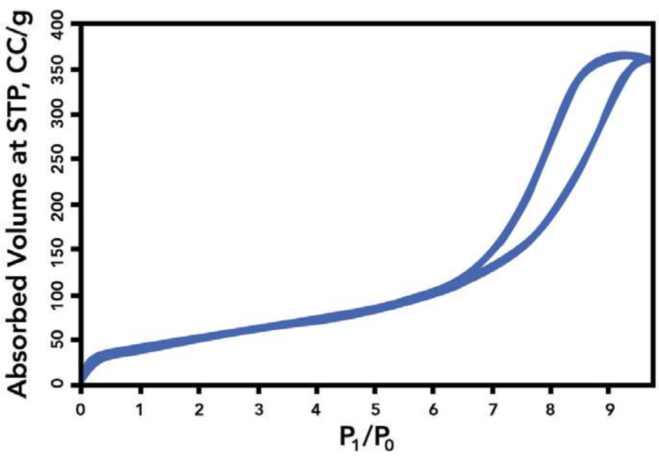


Fig.2 Adsorption and Desorption Isotherms - Water Vapor at 0˚C

Vapor Condensation

As the relative vapor pressure (P/P_0) increases, vapor eventually condenses in the pores utilizing the surface free energy available due to replacement of the solid/vapor interface by solid/liquid interface. The amount of vapor condensed in pores gives the pore volume, and the Kelvin equation gives the pore diameter.

$$\ln\left(\frac{P}{P_0}\right) = -\frac{4\gamma V \cos\theta}{DRT}$$

Where:

γ = surface tension of condensed liquid

V= molar volume of condensed liquid

θ = contact angle

D = pore diameter

R = gas constant

T = absolute test temperature

Adsorbed layers of molecules form on the pore walls before condensation fills the pores. Therefore the actual pore diameters are computed by adding two times the thickness of the adsorbed gas layer to D.

A complete adsorption isotherm is determined by measuring the amount of vapor adsorbed as a function of increasing pressure. A desorption isotherm is determined by measuring the amount of adsorption as a function of decreasing pressure. Based on this technique, characteristics of materials related to adsorption, desorption, surface area and pore volume can be determined.

Pore Volume & Pore Diameter

Pore volume, pore diameter and pore volume distribution can be determined accurately by the PMI BET Sorptometer. The distribution function is such that area under the function in any pore diameter range is the volume of pore in that range.

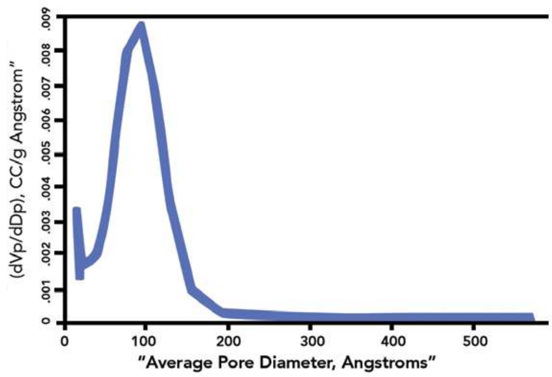


Fig.3 Pore Volume Distribution

Pore Structure Characteristics:

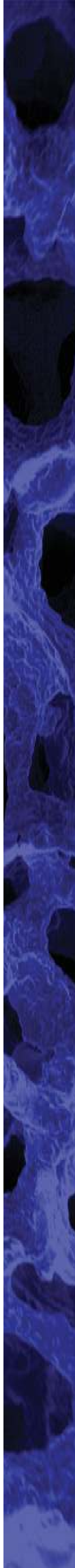
- Mean Pore Size
- Pore Size Distribution
- Total Pore Volume
- Single Point Surface Area
- Multi-Point Surface Area
- Adsorption & Desorption Isotherms

Sample Characteristics

- **Pore Size Range:** 1nm to > 200 nm
- **Surface Area Range (in m^2/g):** 0.01
- **Gas Adsorbates:** Nitrogen, Krypton
- **Sample Volume:** 10 cc (others available)
- **Micropore Volume Range:** Detectable within 0.0001 cc/g
- **Sample Chamber:** 1
- **Vacuum Level:** Upto 10^{-3} Torr

Pressure Transducers:

- **1000 mmHg Pressure Transducer**
  Pressure Transducer Resolution: 1 part in 10,000
  Pressure Transducer Accuracy: 0.15% reading
- **10 mmHg Pressure Transducer**
  Pressure Transducer Resolution: 1 part in 10,000
  Pressure Transducer Accuracy: 0.15% reading
- **0.1 mmHg Pressure Transducer**
  Pressure Transducer Resolution: 1 part in 10,000
  Pressure Transducer Accuracy: 0.15% reading
- **Dead-end & Through-pores**
- **Adsorption temperature:** -195.6°C (Nitrogen)
- **Regeneration system (Pretreatment system):**
  Temperature Range: Ambient to 450°C
- **Power Requirements:** 220 VAC/ 50 Hz



Features

- In situ outgassing: **No need for extra outgassing stations**
- Automated Control
- Both Single and Multi point BET
- Display of full adsorption and desorption isotherms
- BJH pore size distribution
- DFT pore size method
- Langmuir Surface Area
- deBoer t-plot method (for measurement of micro pore volume in cc/g & micropore area in m^2/g)
- Microporesize distribution (by Horvath-Kawazoe method)

Software

- BETWIN software for data acquisition and analysis
- Unlimited data points
- Displays full adsorption and desorption isotherms
- Automated control with data collection and ability to export data to MS Excel or other programs
- Measurement/calculation of dead/free volume and provision to feed it manually in the software

Fig.4 Software Main Screen

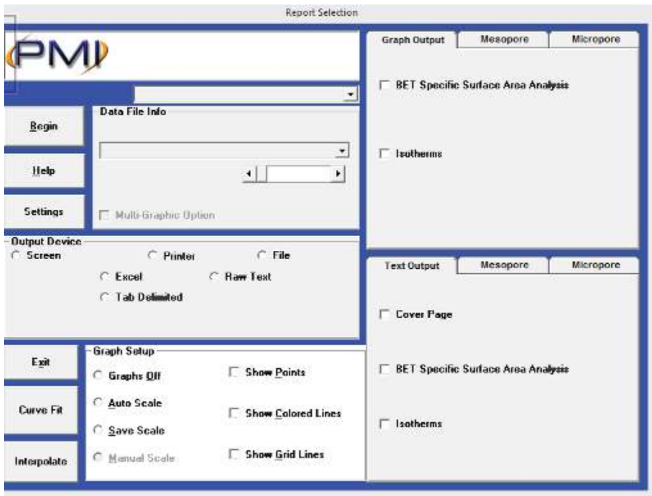


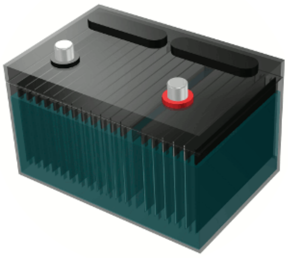
Fig.5 Report Selection Screen

APPLICATIONS

- Pharmaceutical/Medical

- Chemical Industry

- Battery/Fuel Cells Industry



- Automotive Industry

- Ceramic Industry

- Filtration Industry

- Paper Industry

And Many more...

SALES & SERVICE

We at Porous Materials Inc., have dedicated sales team helping thousand's of our customers identify the right solution for their scientific problems. We are also proud to offer customized instruments for your unique needs. Our service and applications team is committed to effective support with short response times, we offer comprehensive range of solutions from new and customized systems, calibration and maintenance to testing services.

Explore more about us at www.pmiapp.com

Customize your machine today !

*Disclaimer: *We are continously improving our products,
Design is subject to change without prior notice.*

The most advanced, accurate, reproducible and easy to use Sorptometers in the world

35 YEARS
CELEBRATING
OF SOLUTIONS

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