THE PMI BET SORPTOMETER

BET- 202A-2OS

Porous Materials, Inc.

Not just products...solutions!

Description

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.

Applications

PMI's BET Sorptometer has a multitude of applications in industries worldwide. Some applicable industries include Rubber, Automotive, Chemical, Ceramic, Paper, Battery Separator, Fuel Cells, Filtration, Pharmaceuticals, and Powder Metallurgy.

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.

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.

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

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 W_m. 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_0 = Avogadro's number
a = cross – sectional area of the adsorbed gas molecule
W_m = amount of gas adsorbed in moles

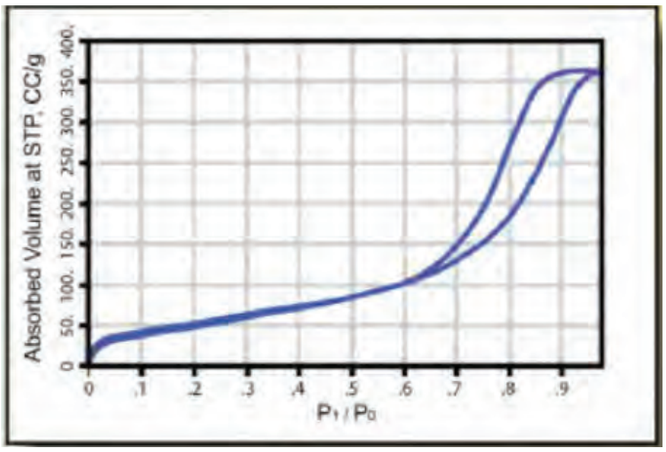

Figure 1
Adsorption and Desorption Isotherms at Liquid N_2 temperature

Vapor Condensation

As the relative vapor pressure (P/Po) 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.

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

Where:

g = surface tension of condensed liquid
V= molar volume of condensed liquid
q = 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.

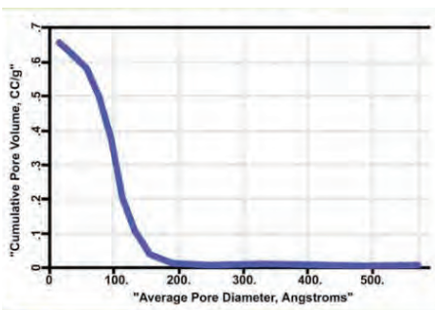

Figure 2
Cumulative Pore Volume

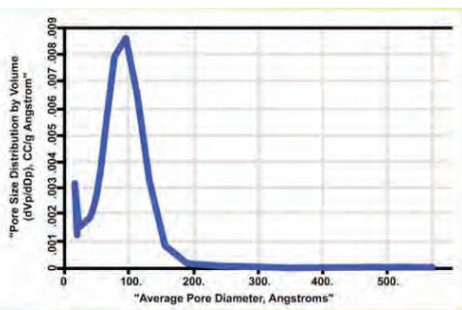

Figure 3
Pore Volume Distribution

Adsorption & Desorption Isoterms

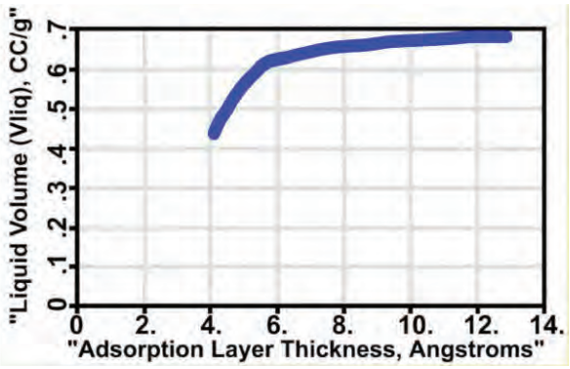

Figure 4
T - Plot Method - Micropore Volume Analysis

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.

Chemisorption

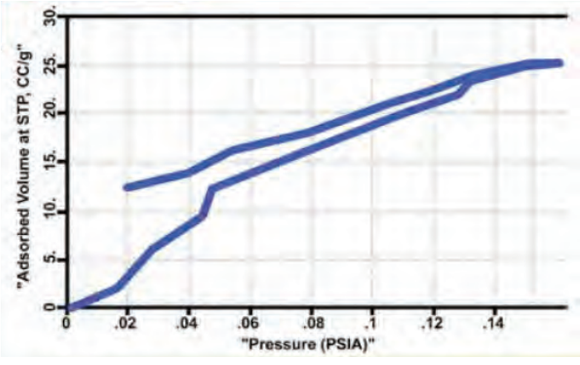

Figure 5
Adsorption and Desorption Isotherms - Water Vapor at 0˚C

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.

Specifications

- **Surface Area Range:** *0.01m^2/g to 0.0005 m^2/g or better*
- **Pore Size Range:** *0.35 to 500 nm or more*
- **Micropore Volume:** *Detectable within 0.0001 cc/g*
- **Pressure Transducer:** *Both the analysis station have 1000 torr, 10 torr and 0.1 torr transducer*
- **Resolution:** *0.000025% 0r better*
  For 1000 torr transducer: 0.00025 mm Hg
  For 10 torr transducer: 0.0000025 mm Hg
  For 0.1 torr transducer: 0.000000025 mm Hg
- **Pressure Transducer Accuracy:**
  <± 0.1% full-scale (1000 torr)
  <± 0.15% of reading (10 & 0.1 torr ranges)
- **Ultimate Vacuum:** *Up to 5 × 10^{-3} mbar*
- **Degas operating temperature:** *Ambient 350 to 450 deg.C*
- **Coolant Level:** *Controlled to ± 0.5 mm with level sensor*

Analysis system:

Two Micropore Analysis Stations with dedicated imported vacuum pump having capability of 5 × 10^{-3} mbar.

Features

- *Adsorption of vapours (such as H_2O, Methanol, Ethanol, Benzene, Toluene etc.) Chosen gas / vapours be automatically selectable through software during analysis*
- **Adsorbates:** *Any Non corrosive gases such as H_2, N_2, Ar, CO_2, He, ethane etc.*
- *Single point & Multipoint BET*
- *Permits fast and reproducible surface area measurements*
- *Volumetric method employed measures equilibrium amount of adsorbed gas precisely without the possibility of any contamination*
- **Isotherms:** *Up to 1000 data points (per station) adsorption and/or desorption Hyteresis Scanning*
- **Surface Area:** *BET, Langmuir, STSA, DFT, BJH or more*
- **Micropores:***NLDFT, QSDFT, Monte-Carlo, t-plot, alpha-s and others*
- **Mesopores:** *NLDFT, BJH, DH or more*
- **Operating methods:** *Classical helium void volume or helium free mode Analysis with degassing*

LN_2 Dewar:

Minimum 3 litres, suitable for providing up to minimum 80 hours of unattended analysis. Cryogen Dewar refilled will not affect the accuracy of the analysis results

Computer & Printer

- *A branded latest configuration PC with, RAM 8 GB, HDD 1 TB, DVD-RW, 2x Gigabit Ethernet network card, ATI Radeon HD6670 1GB,*
- *Windows 7 Ultimate 64-bit or better*
- *Branded Laserjet printer*

Software:

Proper software to be supplied for smooth running of the system with provision for all types of (mentioned) calculations and free up gradation of the software for at least three years post purchase

UPS:

5 kVA with at least 1 hr backup

Sales & Services

Our sales team is dedicated to helping our customers find which machine is right for their situation. We also offer custom machines for customers with unique needs. To find out what we can do for you, contact us. We are committed to customer support including specific service products, short response times & customer specific solutions. To quickly & flexibly meet our customer's requirement, we oller a comprehensive range of services.

Customize your machine today!

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

Celebrating

35 years

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