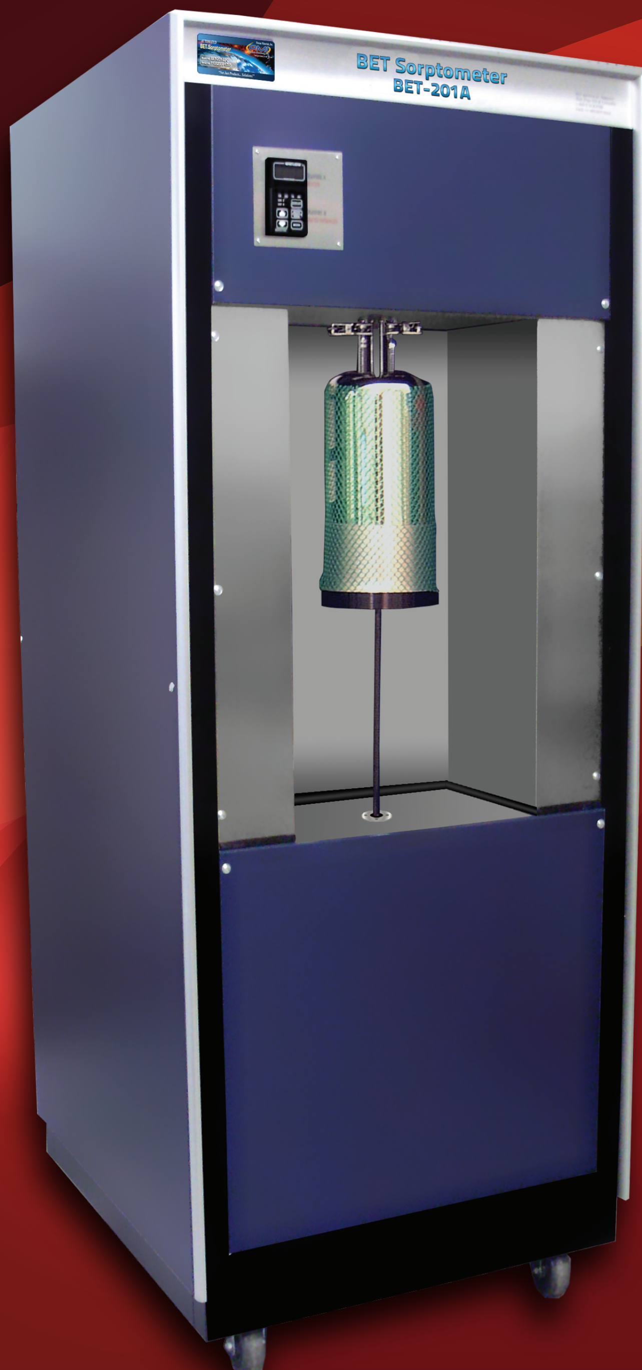
Porous Materials, Inc.



The PMI Advanced

BET SORPTOMETER

BET-201-A

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 as well as the kinetics of adsorption.

Application

PMI's BET Sorptometer has a multitude of applications in industries worldwide. Some applicable industries include Automotive Industry, Battery/Fuel Cells Industry, Ceramic Industry, Chemical Industry, Filtration Industry, Paper Industry, Pharmaceutical/Medical Industry, Powder Metallurgy Industry, etc.

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.

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.

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

Where:
W = amount of adsorbed gas
Wm = 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_0 = **Avogadro's number**
a = cross – sectional area of the adsorbed gas molecule
Wm = amount of gas adsorbed in moles

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 D = pore diameter
V= molar volume of condensed liquid R = gas constant
q = contact angle   T = absolute test temperature

Adsorbed layersof 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.

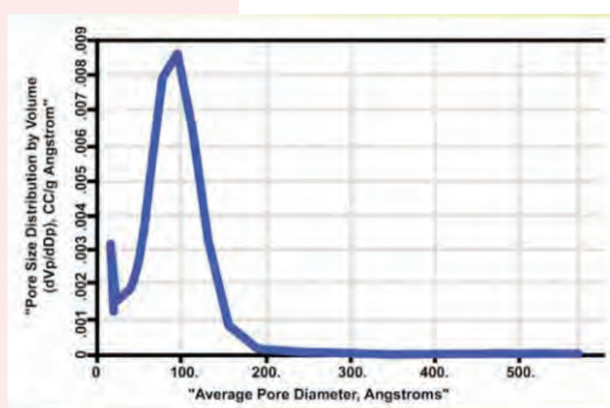


Figure 1
Pore Volume Distribution

Chemisorption

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.

Specification

Pore Structure Characteristics:

1. Mean Pore Size
2. Pore Size Distribution
3. Total Pore Volume
4. Single Point Surface Area
5. Multi-Point Surface Area
6. Adsorption & Desorption Isotherms

Sample Characteristics:

1. Pore Size Range: 10nm-500 microns
2. Surface Area Range: 10-2,000 M^2/g platinum
3. Dead-end & Through-pores

Features

1. In situ outgassing: No need for sample transfer
2. Automated Control
3. SINGLE Point BET surface area & pore distribution.
4. Specifically designed for Carbon Blacks

SOFTWARE

Suitable Microsoft software and other interfacing & integration for carrying out the measurement and analysis with high levels of reliability and accuracy. Software has been capable of performing the following tasks:

- Generate both 'Single- and Multi- point BET specific surface area'
- Generate all the measured 'Adsorption and Desorption Isotherms'
- Langmuir surface area with slope, intercept, constant and correlation co-efficient
- Mesopore volume and Mesopore area distribution by BJH, HK and other models
- T-plot for micro pore area & volume
- Density functional theory to generate various parameters, e.g.,:
- Micro pore and mesopore distributions

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 offer a comprehensive range of services.

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

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