Automated Mercury/Non-mercury Intrusion Porosimeter

AMP-60K-A-1

PMI
Porous Materials, Inc.

Not just products...solutions!

Description

The PMI Automated Mercury Intrusion Concrete Porosimeter is a versatile and accurate instrument used to determine properties such as porosity, pore size distribution, average pore size and total pore volume of concrete, rock chips, grains or solid cylindrical samples. With unlimited user-defined data-points, automated data collection and reduction, and the least mercury exposure of any porosimeter on the market, PMI's is a versatile and accurate instrument used to date is safe, reliable, and precise.

Principles of Operation

The PMI Automated Mercury Intrusion Porosimeter is a versatile and accurate instrument used to determine pore volume. The Automated Mercury Intrusion Porosimeter fills the penetrometer and sample chamber with mercury under high pressure and takes a volume reading. Gradually, increasing amounts of pressure are applied on the nonwetting liquid. For each incremental increase in pressure, the change in intrusion volume is equal to the volume of the pores whose diameters fall within an interval that corresponds to the particular pressure interval. Generates intrusion as well as extrusion curves.

The PMI Porosimeter consists of a low pressure section, a high pressure section, and penetrometers connected to the sample chambers. The low pressure section includes the mercury reservoir and the mercury trap, and can be opened to the atmosphere or evacuated. The high pressure section includes a pressure generator that uses isopropyl alcohol as the hydraulic uid to pressurize mercury. The sample is placed inside a stainless steel cell that has a hole on one of its sides for evacuation and entry of mercury into the cell.

The cell is closed with a lid and placed in the sample chamber. Intrusion volume of mercury is measured by noting changes in mercury level in the penetrometer with a magnetic sensor. Exposure to mercury is negligible due to the unique design of the instrument. The unique design also permits use of nonmercury nonwetting liquids for intrusion. Another instrument design uses water as the nonwetting liquid and uses absolutely no mercury. The instrument is known as the Aquapore.
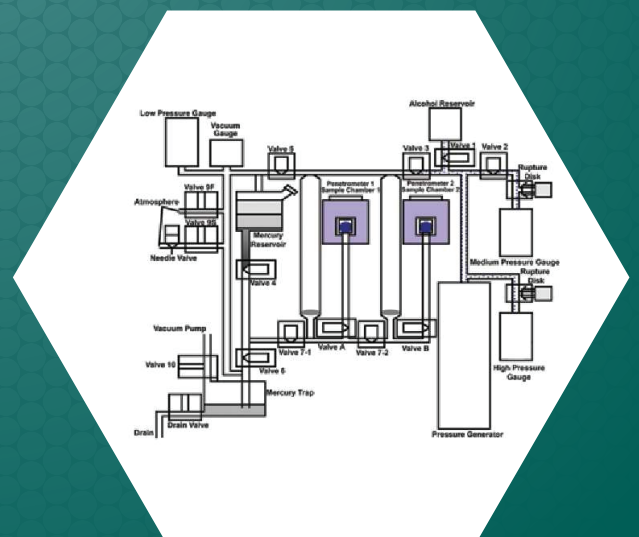
Operating Procedure

A nonwetting liquid like mercury does not spontaneously fill pores of a sample because the sample/nonwetting liquid surface free energy is greater than the sample/gas surface free energy. However, application of pressure can force a nonwetting liquid into the pores of a sample. The differential pressure required to force the nonwetting liquid into a pore is given by:

P = - 4 g cos q / D
P = differential pressure D = pore diameter
g = surface tension of nonwetting liquid
q = contact angle of the nonwetting liquid with the sample

The pore diameter at any location in a pore is de
ned such that (dS/dV) = (4/D), where (dS/dV) is the ratio of small increase in surface area due to a small increase in volume of nonwetting liquid in the pore. In this technique the pressure and
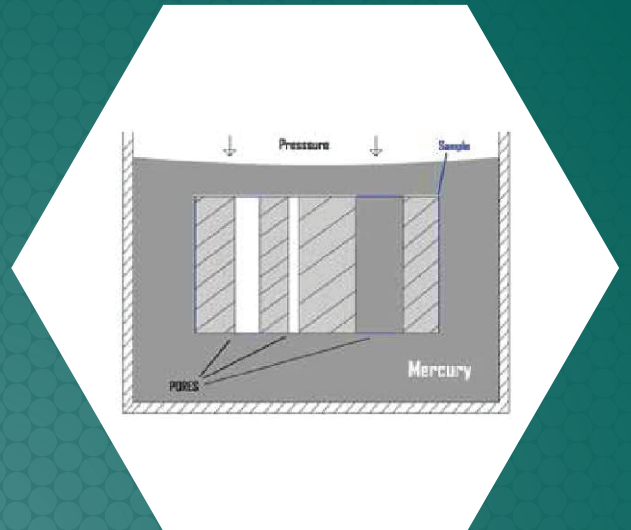
the volume of intruded nonwetting liquid are accurately measured. Combining these data with the surface tension and the contact angle of the liquid, pore diameter, pore volume, pore volume distribution and pore surface area are computed.

Data Report

- Pore volume versus diameter
- Delta volume (histogram)
- Pore distribution (histogram)
- Percent total pore volume
- Pore distribution (pressure and diameter)
- Particle size distribution (histogram)
- Percent porosity and density
- Cumulative surface area
- Porosimetry text data
- Summary sheet (reporting median pore sizes based on volume and surface area along withbstandard deviations)
- Auto merging of low and high pressure data in a single graph over the entire analysis range.

- *Windows 7 Pro compatible software enables convenient use of the instrument.*

- *User defined contact angle and surface tension can be entered.*

- *Data can be collected either at user-specified pressure values, at user-specified intrusion volume values, or at evenly spaced user-specified number of data points.*

- *Equilibrium conditions are also user adjustable.*

- *Multiple users and/or sample types can be given their own software "group". The software settings are remembered independently for each "group".*

- *Outgassing and pretreatment performed either automatically or manually. The user can skip the normal automatic outgassing procedure.*

- *Testing can be paused at any time. While a test is paused, the software allows full manual operation of the instrument while retaining the ability to continue the test when manual control is completed.*

- *Separate software for report generation enables the user to plot up to seven test results on the same graph. Report generation does not have to be performed on the same computer that controls the instrument.*

- *The report software allows data to be converted directly into an Excel spreadsheet or exported to standard text or tab-delimited database or other programs.*

- *The software features curve fitting and interpolation routines that help in better analysis of the data.*

- *Desired pressure units can be selected for the reports independent of the units in test.*

- *Diagnostic menu, easy to identify problems*

- *Report software enables user to view reports, modify scales in graphs and print reports.*
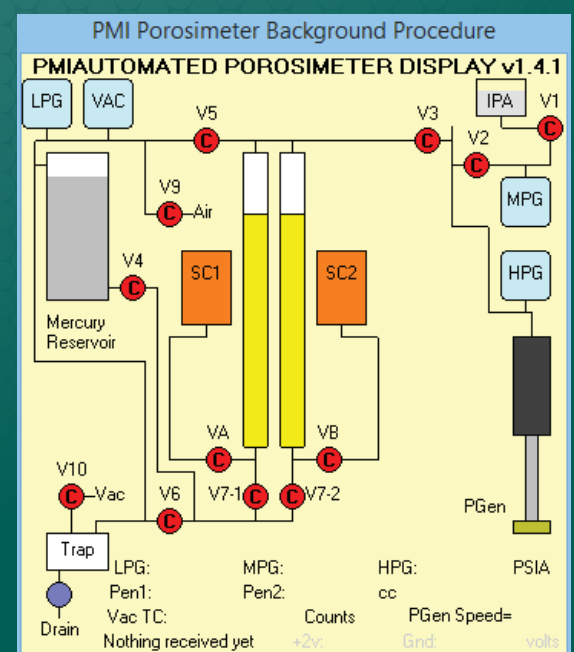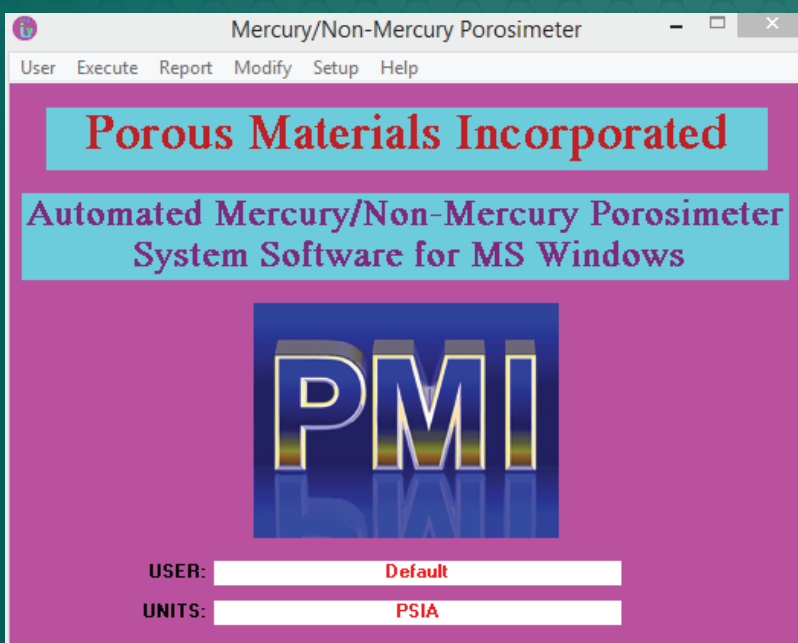
Unique Features

- *Mercury and Non-mercury (other non-wetting liquid) Porosimetry can be performed in the Porosimeter.*
- *A unique system design allows use of the sample chamber to be connected to or isolated from the low pressure and high pressure sections of the instrument. This allows fully automated testing with no requirement to transfer samples from a low pressure station to a high pressure station in the middle of the test.*
- *Equipment design allows extrusion to be performed even at sub atmospheric pressures.*
- *Operator involvement is minimum.*
- *Automatic clean-out routines after test limit the amount of mercury exposure.*
- *Samples can be tested at elevated or sub-ambient temperatures.*
- *Sample chamber and penetrometer are made out of stainless steel.*
- *Novel design enables sample chamber and penetrometer tube to be changed individually and independently.*
- *In-situ pretreatment of samples is preformed to avoid contamination.*
- *Ability to test concrete, sandstone, carbonate, mortar, and cement paste*

Pore Structure Characteristics:

- *Mean Pore Size*
- *Pore Size Distribution*
- *Total Pore Volume*
- *Porosimetry Surface Area*

- *Bulk Density*
- *Absolute Density*
- *Particle Size Distribution*

Applications

1. *Catalyst Industry*
2. *Various Stone Industries*
3. *Cement Industries*
4. *Automotive Industry*
5. *Battery/Fuel Cells Industry*
6. *Ceramic Industry*

7. *Chemical Industry*
8. *Filtration Industry*
9. *Paper Industry*
10. *Pharmaceutical/Medical Industry*
11. *Powder Metallurgy Industry*

And many more...

Features

- *Test Substance (Mercury as well as non mercury)*
- *Automated Control of mercury level, transfer of fluids and calibration of sample cell.*
- *Ability to test concrete, sandstone, carbonate, mortar, and cement paste.*
- *Manual control also possible*
- *Unlimited user-defined data points based on pressure, volume, or a combination Displays both intrusion and extrusion curve*
- *Real-time graphical test display shows testing status and results throughout operation*
- *Export of data to excel or other format.*
- *Minimal maintenance required.*
- *Mercury recovery kit included*
- **Software for Data Analyses:** *Windows-based software handles all control, Pore size distribution, Pore area and pore volume distribution, average pore size, density, contact angle, particle size distribution (Powders), data collection, and report.*

Specifications

- **Pore Size Range:** *0.003 - 950 microns or wider*
- **Pressure increment mode:** *Step and continuous*
- **Sample Size:** *1" by 2"*
- **Accuracy:** *±1% of full scale or better of intrusion volume, ±0.1mm_ resolution*
- **Pressure Range:** *Vacuum to 60,000 psi*
- **Pressure Transducer Range:** *0 - 60,000 psi*
- **Pressure Transducer Accuracy:** *±0.15%*
- **Transducer Hysteresis:** *±0.10%*
- **Transducer Resolution:** *5×10^{-4} psi or better*
- **Volume Resolution:** *0.1micro liter or better*
- **Resolution:** *1 in 60,000*
- **Power Requirements:** *220-230 VAC, 50 Hz (Others available)*
- **Dimensions:** *72" H x 30" W x 30" D*
- **Weight:** *200Kg*
- **Sample Cell (Stainless Steel) Volume:** *Upto 20ml (Min) with sample dimensions up to 25mm diameter (min) x 50mm length (min)*
- **Sample Chamber :** *One sample chamber, low pressure and high pressure (No need to transfer the sample chamber during the test).*
- *Sample Cell to accommodate about 20cc bulk volume.*

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

Celebrating

35

years

of solutions

PROUDLY
MADE IN USA

PMI
Porous Materials, Inc.

20 Dutch Mill Rd, Ithaca, NY 14850, USA
Toll Free (US & Canada): 1-800-TALK-PMI (1-800-825-5764)
Phone: 607-257-5544 Fax: 607-257-5639

Email: info@pmiapp.com   www.pmiapp.com