

Liquid Extrusion Porosimeter

Unique Features

Liquid Extrusion Porosimetry	Mercury Intrusion Porosimetry
No toxic substance used	Mercury used
Low test Pressure and negligible structural distortion	An order of magnitude higher test pressure and appreciable structural distortion
Sample reusable	Sample discarded
Liquid permeability measurable	Permeability not measurable
Only through pores measurable	Through & Blind pores measurable
Sample with pore diameter 2000 μm measurable	Samples with greater than 200 μm pores difficult to measure

Specifications

Pressure Range: 0 – 100 psi (Others Available)
 Resolution: 1 in 20,000
 Pore size: 2000 μm – 0.05 μm

Intrusion Volume Range: 0 – 50 cc (Others Available)
 Intrusion Volume Resolution: 0.01 cc
 Sample Size: 1.5" Diameter, 1" Thick (Others Available)

Other Products

Average Fiber Diameter Analyzer	Integrity Analyzer	Mercury/Nonmercury Intrusion Porosimeter
Bubble Point Tester	In-Plane Porometer	Porosimeter
Capillary Flow Porometer	Microflow Porometer	Water Intrusion Porosimeter (Aquapore)
Complete Filter Cartridge Analyzer	Multi-Chamber and Multi-Mode Porometer	BET Liquisorb
Clamp-On Porometer	QC Porometer	BET Sorptometer
Compression Porometer	Diffusion Permeameter	Gas Pycnometer
Cyclic Compression Porometer	Gas Permeameter	Mercury Pycnometer
Envelope Surface Area Analyzer	Liquid Permeameter	
Filtration Media Analyzer	Vapor Permeameter	Also Available:
High Flow Porometer	Water Vapor Transmission Analyzer	Testing Services
		Consulting Services

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Application

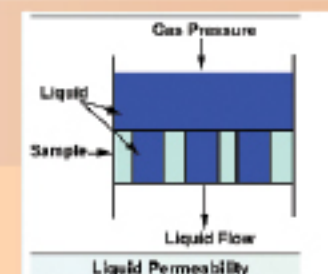
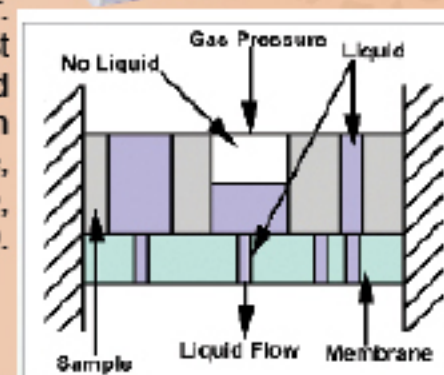
The PMI Liquid Extrusion Porosimeter is a unique instrument with the ability to measure through-pore volume, pore distribution, and liquid permeability without using mercury. The instrument is employed for characterization of porous materials used in many industries such as biotech, pharmaceutical, filtration, food, and environmental industries, and it produces no harmful effects on personnel or the environment.

Principle of Operation

The sample is placed on a membrane in the sample chamber. The membrane is such that its largest pore is smaller than the smallest pore to be tested. The pores of the sample and the membrane are filled with a wetting liquid. The pressure of a nonreacting gas is increased on the sample to extrude the liquid from the pores. The differential pressure, p , required to displace liquid from a pore is related to its diameter, D , surface tension of the liquid, γ , and contact angle of the liquid, θ .

$$p = 4 \gamma \cos \theta / D$$

The displaced liquid passes through the liquid-filled pores of the membrane and its volume is measured, while the membrane prevents the gas from passing through because of insufficient pressure. The gas pressure gives the pore diameter. The volume of displaced liquid gives the pore volume. Measurement of liquid flow rate without the membrane under the sample yields liquid permeability of the sample.

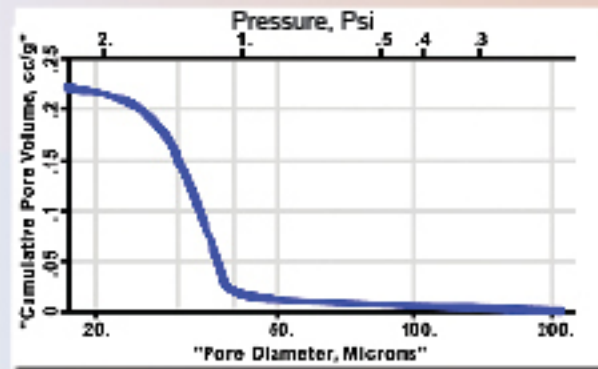


Unique Throughpore Characteristics

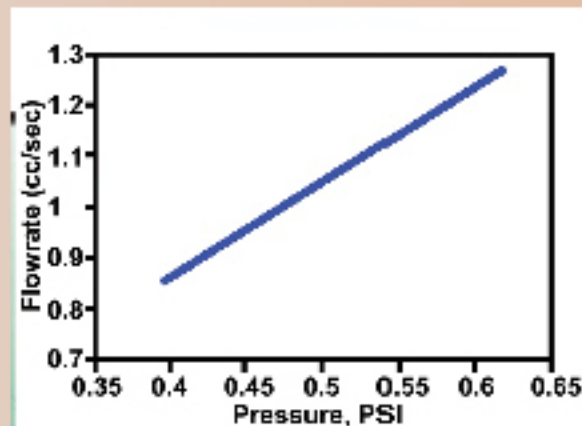
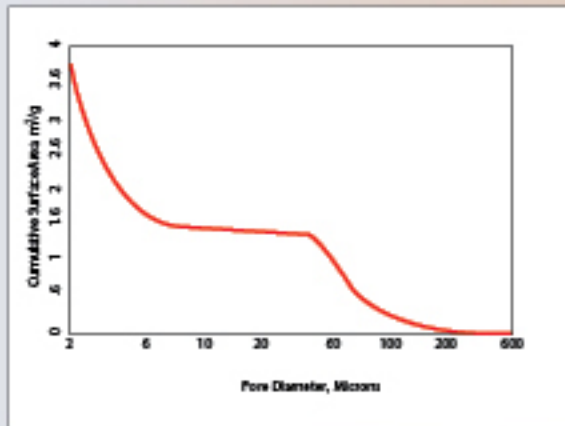
- Only instrument capable of measuring throughpore
- Throughpore diameter measurable up to 2,000 microns
- Throughpore volume distribution given in terms of distribution

$$f_v = - (dV / d \log D)$$

Area under the function in any diameter range yields volume of pores in that range

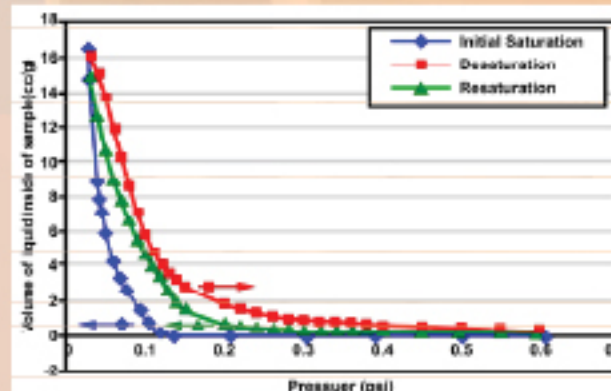


- Throughpore surface area $S = \int (4/D) dV$
- Liquid Permeability computed from variation of pore volume with diameter converging and diverging nature of pores



Saturation Volume, Desaturation Volume, and Resaturation Volume

- Liquid uptake for saturation of a sample
- Liquid expulsion from a saturated sample
- Liquid uptake during resaturation
- Cyclic saturation-desaturation-resaturation
- Hysteresis effect



The Instrument

- A fully automated instrument with very little operator involvement
- Automated data acquisition, data storage, and data reduction
- Versatile: Can test a wide variety of materials using different liquids
- Windows based, simple operation
- Table-Top models require only compressed air supply

Use of Application Environments

• Compressive Stress

Many products operate under compressive stress in application environment. Therefore, pore structure characteristics of sample under compressive stress are required. The liquid extrusion porosimeter has the ability to test samples under compressive stress.

• Elevated Temperature

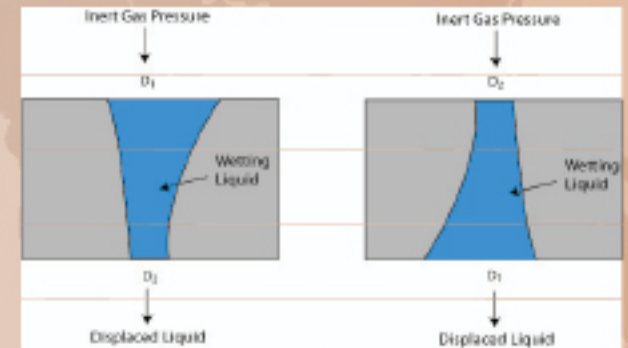
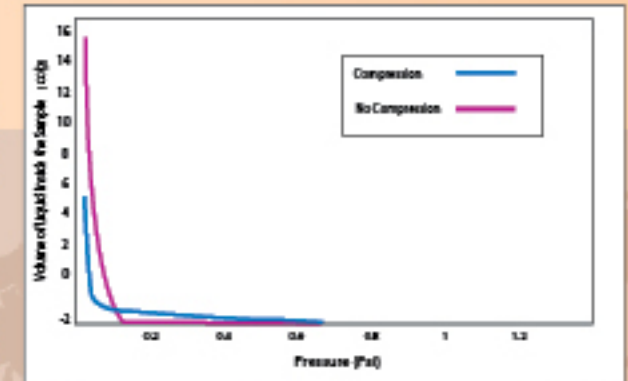
Tests in the liquid extrusion porosimeter can be performed at elevated temperatures up to 200°C. The high temperature liquid extrusion porosimeter can be used to test filtration media used in high temperature filtration of products, such as sugar solutions and to measure permeation of fat through cooked food.

• Chemical Environment

Many materials are stable only in certain specific chemical environments. Therefore, it is desirable to use the application liquid for the test. The liquid extrusion porosimeter is versatile enough to permit the use of many liquids including glycerin, water, galwick, and triton for the test. For example, hydrogels are stable only in water. Hydrogels can be tested in liquid extrusion porosimeter using water. Pore structures can be different in different humidity conditions. The instruments can be made to operate under desired humidity conditions.

• Converging and Diverging Pores

The instrument can detect if the through pores are converging or diverging.



Comparison With Mercury Intrusion

- Same pore volume measured by both techniques
- Greater resolution by liquid extrusion
- Distortion of pore distribution by mercury intrusion

