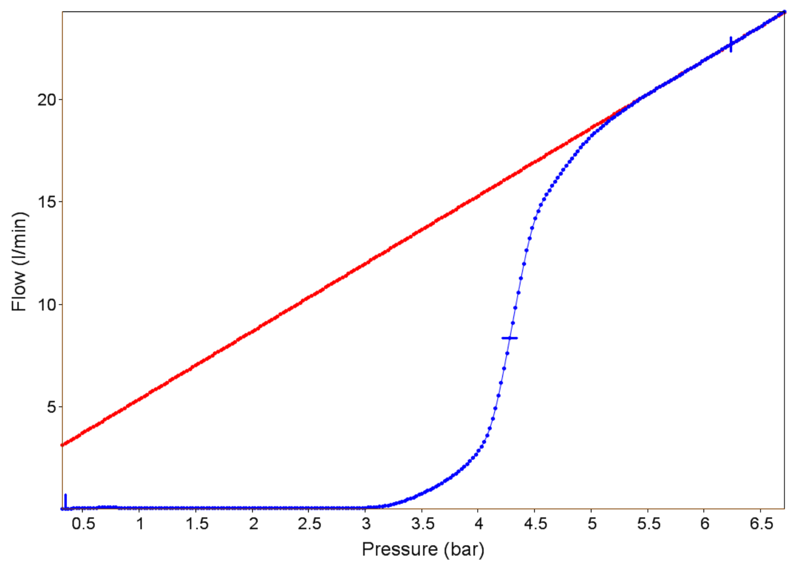
ebatco

Exponential Business and Technologies Company

Bridge You and Nano

Nano/micro Pore Size and Pore Size Distribution Measurement

Filtration systems rely on filters to remove unwanted materials and contaminants or allow only certain kinds of solutes to pass through in order to achieve separation purposes. It is obvious that pore size and its distribution are important parameters for a filtration material. These parameters can be measured by a porometer. The measuring technique is called porometry.



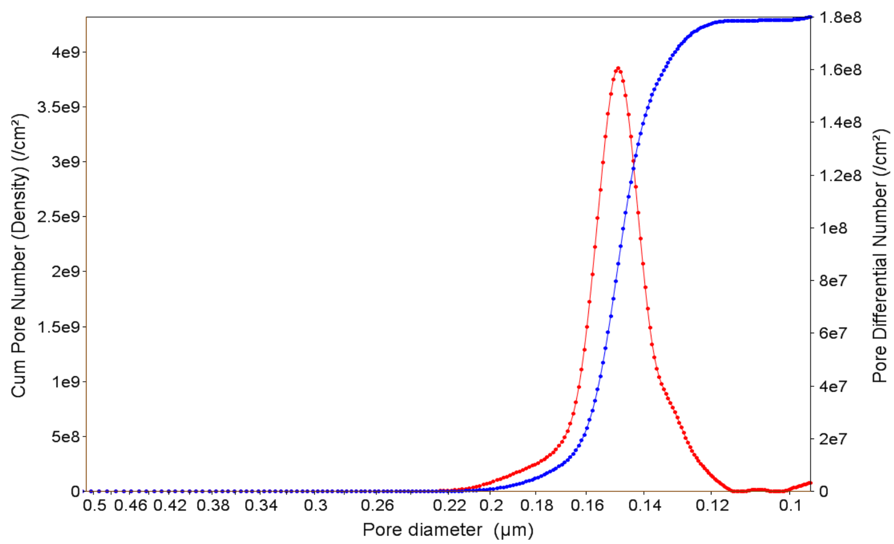


Figure 1. Wet and dry run data (top) and pore size distribution (bottom) used in characterization of the pores of a filtration membrane.

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A porometer such as the one equipped in Ebatco's Nano Analytical and Testing Laboratory (NAT Lab) is an instrument that is used for analyzing porosity characteristics of materials. In general, a porometer employs a liquid displacement technique to measure the pore size distribution of a sample (media/material). The sample is first thoroughly wetted with liquid of low surface tension and low vapor pressure such that all of the pores of the sample have been filled with the liquid. Then the wetted sample is subjected to an increasing pressure, applied by a gas source. As the pressure of gas increases, it will reach a point where it can overcome the surface tension of the liquid in the largest pores and will push the liquid out of the sample. Increasing the pressure still further allows gas to flow through smaller pores, until all of the pores have been emptied. By monitoring the pressure applied to the sample and the mass flow through the sample while the wetting liquid is being expelled, a 'wet' run is obtained for the sample. If the sample is then tested 'dry' without wetting fluid in its pores, a 'dry' run is obtained. By comparing the flows on the 'wet' run with those from the 'dry' run, the pore size distribution can be calculated using the following equation:

Eq. 1 $$r = \frac{2\gamma \cos\theta}{p}$$

Where γ is the surface tension of the liquid, θ is the contact angle, p is the hydrostatic pressure and r is the radius of the pore.

An example of the wet (blue color curve) and dry (red color curve) runs and cumulative pore number (blue color curve) and differential pore number (red color curve) is shown in Figure 1. The properties that a porometer can measure on a filtration material include bubble point flow rate, bubble point pressure, maximum pore size, mean flow pore size, minimum pore size, pore size distribution, pore density, pore volume, pore surface area, and gas/liquid permeability.

Porometry is not limited to just for filtration materials. A porometer can be used to characterize virtually any porous materials with open pores such as biomedical porous materials, fabrics, fuel cell membranes, meshes, papers, sintered metals and ceramics. The pore sizes that our porometer can measure are from a few nanometers to 500 microns.