



Typical Application of PMI Instruments in the Fuel Cell Industry

The Toray paper, a carbon coated material, is extensively used in fuel cell industry. The pore structure characteristics of this material govern the performance of the fuel cell components. The PMI pore structure characterization instruments can measure the many interesting pore structure characteristics of the Toray paper.

Volume of Different Kinds of Pores

Different functions of fuel cell components are governed by different kinds of pores. Volume of three different kinds of pores in Toray paper was measured by PMI instruments and is illustrated in Figure 1. The instruments used for these measurements are summarized below.

- (i) Volume of the through pores: Measured by PMI Liquid Extrusion Porosimeter
- (ii) Volume of through and blind pores: Measured by PMI Mercury Intrusion Porosimeter
- (iii) Volume of through and blind hydrophobic pores: Measured by PMI Non-Mercury water Intrusion Porosimeter

Through pores constitute about 75 % of the pore volume. About 25 % of the pore volume is due to blind pores. Hydrophobic pore constitute 29 % of pore volume and 71 % of the pore volume is due to hydrophilic pores.

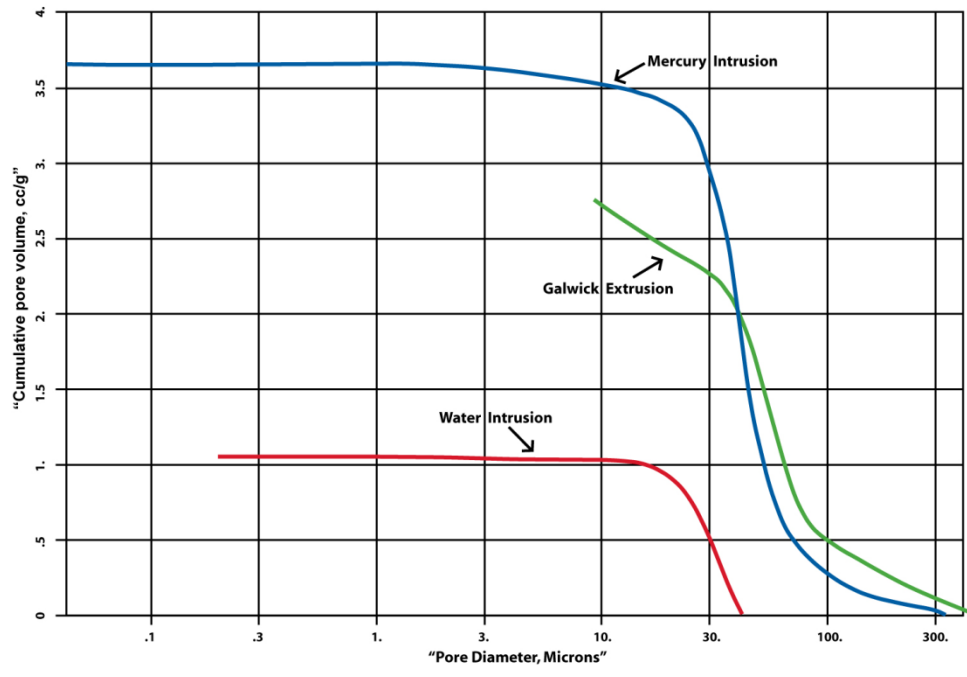


Figure 1. Pore volume of different kinds of pores

Pore Volume Distribution of Different Kinds of Pores

The measured pore volume distribution shows how the three different types of pores (through and blind pores, through pores, and hydrophobic pores) are distributed. The differences between the peaks can be used to estimate the distribution of blind pores and hydrophilic pores. The median pore diameters of various kinds of pores are shown in Table I. It is apparent that the through pores are primarily hydrophilic while the blind pores are primarily hydrophobic. The hydrophilic through pores can also be measured by water extrusion technique.

Hydrophilic Through Pores: Measurable by PMI Water Extrusion Porosimeter

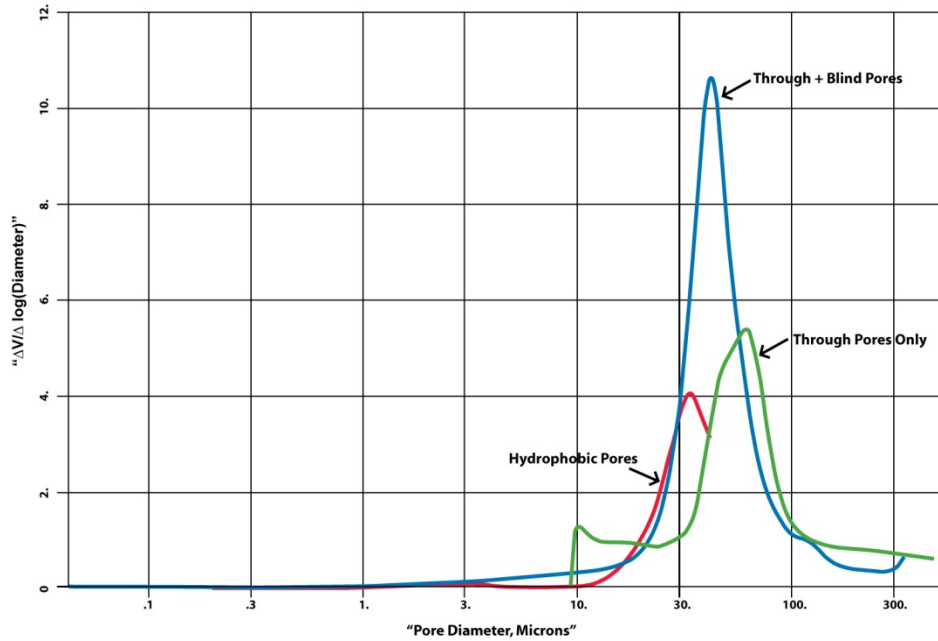


Figure 1. Pore volume distribution of pores

Table I Pore Structure Characteristics

<u>Characteristics</u>	<u>Through Pores</u>	<u>Blind Pores</u>	<u>Hydrophobic Pores</u>	<u>Hydrophilic Pores</u>
% Pore Volume	75 %	25 %	29 %	71 %
Median Pore Diameter	60 μm	40 μm	35 μm	50 μm
Kind of Pore	Hydrophilic	Hydrophobic	Blind Pores	Through Pores



Characteristics of Through Pores Responsible for Fluid Flow

Pore throat diameters determine the flow rate of fluid through the through pores and the restrictions for passage of large particles through the through pores. Characteristics of pore throat diameters of through pores can be determined by PMI pore structure characterization instruments.

Pore Throat Diameters of Through Pores: Measured by PMI Capillary Flow Porometer

This technique measures the largest pore throat diameter, the mean flow pore throat diameter, and the pore distribution. The pore distribution is in Figure 3. The pore throat characteristics of through pores are listed Table 2.

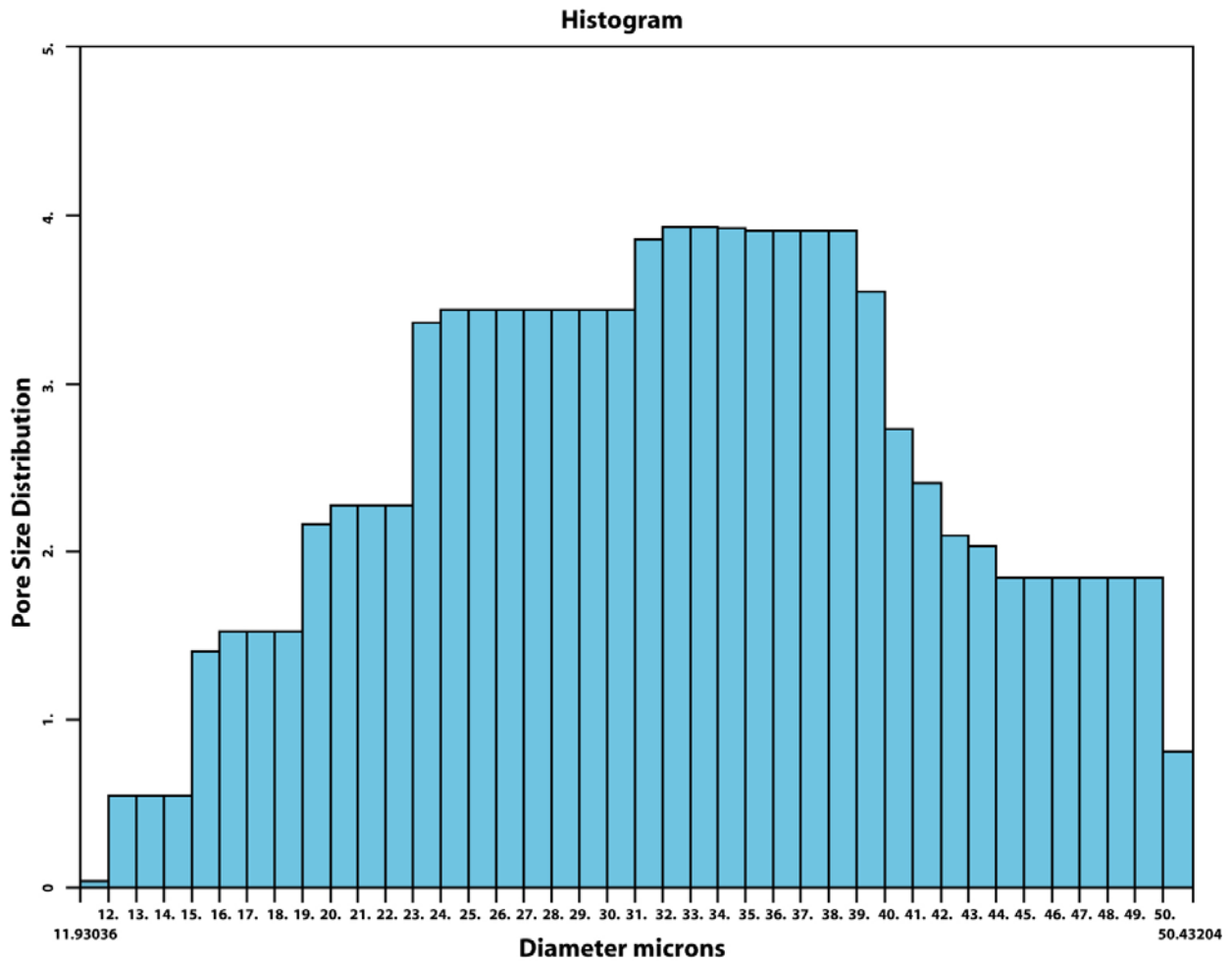


Figure 3. Distribution of through pore throat diameters

Table 2. Characteristics of Through Pores

Characteristics	Values
The Largest Throat Diameter	50.43 μm
Mean Flow Throat Diameter	32.48 μm
Range of Throat Diameters	20 - 45 μm
Change of Pore Diameter Along Pore Length	Small
Median Pore Diameter based on Volume	60 μm
Volume of Pores	75 %
Nature of pores	Hydrophilic

The distribution plot shows that most of the through pore throat diameters are in the range of 20 to 45 μm . Comparison of these value with the diameters of through pores based on volume measurements (Figure 3 and 4) shows that the shapes of through pores are not like hour glasses. The through pore diameters do not change appreciably along the pore length and are similar in magnitude.

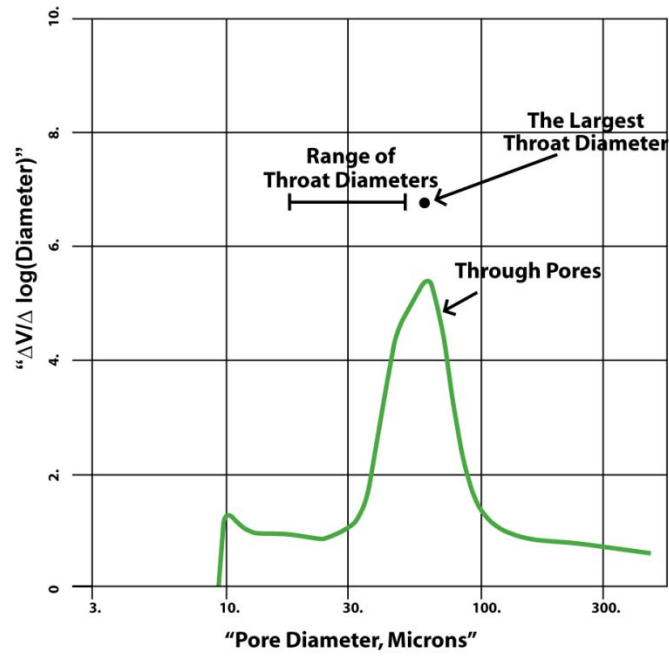


Figure 4. Pore throat diameters and volume based pore diameters of through pores