The Mayer-Stowe Method for Determining Particle Size Using the AutoPore IV Series Porosimeters

Theoretical models of mercury intrusion mechanisms allow information about particle size to be extracted. These models are included in the AutoPore IV Series data reduction package.

In 1965, Mayer and Stowe* published a paper on the mercury breakthrough pressure required to penetrate a bed of packed spheres and the subsequent filling of the interstitial void. This work related particle size to breakthrough pressure and later led to a method for determining the size distribution of particles from the intrusion data in the range of interstitial filling.

This method is based on models of penetration of fluids into the void spaces of a collection of uniform solid spheres packed in a regular manner. The forces resisting penetration of mercury between particles originate from interfacial tensions just as with penetration of mercury into capillaries. The simplest geometry exists when the particles are closely packed monosized spheres in which the shapes of the void necks and void cavities of such a system are calculable.

Regardless of the actual particle shape, the particle size distribution derived from this method is the size distribution of equivalent spheres that, when applied to the mathematical model, most closely reproduces the experimental penetration data. The size unit, then, is 'equivalent spherical size.' How closely the results compare to that obtained by other methods of particle sizing depends largely on how closely the sample material conforms to the model of closely packed spheres.

Information based on the Mayer-Stowe method can be displayed in the Summary Report, in a Tabular Report, or in a Graph. From the Report Options Window, select the report format(s) you wish to display and click Edit to specify data based on the Mayer-Stowe method.

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* R.P. Mayer and R.A. Stowe, *J. Colloid Interface Sci. 20,* 893 (1965).

From the Report Options dialog, select Cum. Vol. vs <variable>, then click **Edit**.

Choose Particle size for the X-axis variable and Cum. Vol. Finer for the Y-axis variable.

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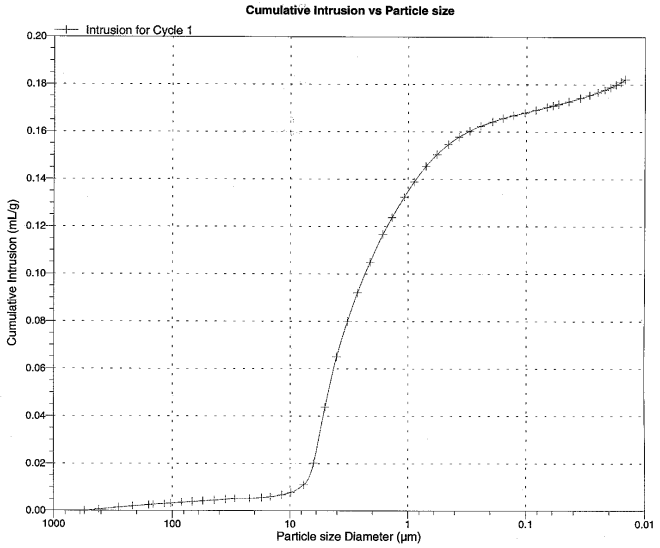
AutoPore IV 9500 V1.03 Serial: 379 Port: 1/1 Page 3

Sample ID: Clay
Operator: N. KELLY
Submitter: Micromeritics International
File: C:\AUTOPORE\DATA\CLAY.SMP

LP Analysis Time: 6/2/98 3:52:14PM
HP Analysis Time: 6/2/98 4:52:15PM
Report Time: 2/8/01 10:17:17AM

Sample Weight: 2.1098 g
Correction Type: Formula
Show Neg. Int: No



From the Report Options dialog, select Tabular Report, then click **Edit**.

Choose Particle Size and Cumulative Volume Finer for your columns.

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AutoPore IV 9500 V1.03 Serial: 379 Port: 1/1 Page 2

Sample ID: Clay
Operator: NK
Submitter: Micromeritics International
File: C:\AUTOPORE\DATA\CLAY.SMP

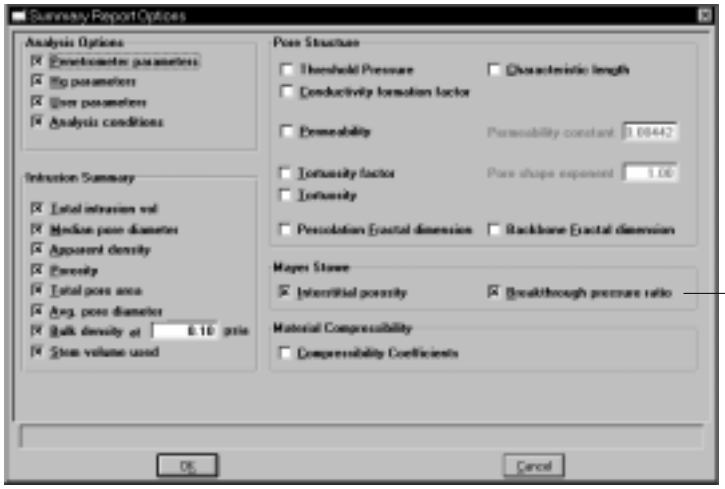
LP Analysis Time: 6/2/98 3:52:14PM
HP Analysis Time: 6/2/98 4:52:15PM
Report Time: 2/8/01 10:17:17AM

Sample Weight: 2.1098 g
Correction Type: Formula
Show Neg. Int: No

Tabular Report

MayerStowe Particle Diameter (µm)	Mayer-Stowe Cumulative Volume finer % (%)	MayerStowe Particle Diameter (µm)	Mayer-Stowe Cumulative Volume finer % (%)	MayerStowe Particle Diameter (µm)	Mayer-Stowe Cumulative Volume finer % (%)
553.7462	100.0000	1.3692	32.0502	0.0249	1.4207
419.4810	99.6839	1.0796	27.2865	0.0322	2.0784
285.8509	99.2295	0.8871	23.7424	0.0421	2.7092
216.8073	98.9430	0.7044	20.1369	0.0552	3.2778
158.3501	98.6368	0.5701	17.4230	0.0710	3.7287
145.4040	98.5380	0.4555	15.0837	0.0915	4.1166
116.4373	98.3602	0.3701	13.3578	0.1210	4.5335
103.1304	98.2614	0.3004	11.9566	0.1542	5.0091
83.5395	98.0836	0.2431	10.8198	0.2073	5.3486
67.6661	97.9157	0.1931	9.8356	0.2690	5.6670
55.0701	97.7379	0.1580	9.0278	0.3447	5.9892
44.0893	97.5502	0.1285	8.3716	0.4462	6.2531
35.3028	97.3427	0.1026	7.7336	0.5895	6.5504
29.4319	97.1353	0.0834	7.1176	0.7367	6.8067
22.0850	97.1353	0.0671	6.4850	0.9793	6.9238
17.5032	96.9854	0.0598	6.0849	1.2605	6.9238
14.7115	96.7571	0.0539	5.7530	1.7592	8.0910
11.7526	96.3204	0.0443	5.1660	2.2192	8.2248
9.8163	95.7251	0.0355	4.3448	2.9668	8.7539
7.6759	93.9595	0.0295	3.6724	3.6668	10.8181
6.3232	88.8719	0.0253	3.0216	4.6225	11.6883
5.0603	75.9304	0.0221	2.4200	6.0613	13.4312
4.0276	64.2877	0.0196	1.8360	8.0063	15.6921
3.2623	56.0957	0.0177	1.2612	10.3794	17.4900
2.6821	49.4604	0.0161	0.6394	13.5134	20.4604
2.1034	42.3682	0.0147	-0.0000	17.5775	24.0658
1.6335	35.9497	0.0191	0.6867	29.4042	31.3586

You can also request information on interstitial filling by selecting options on the Summary Report. On the Report Options dialog, select Summary Report in the report window, then click **Edit**.



Request information on interstitial filling by selecting either or both of these options to include on the Summary Report.

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AutoPore IV 9500 V1.03 Serial: 379 Port: 1/1 Page 1

Sample ID: Clay
Operator: NK
Submitter: Micromeritics International
File: C:\AUTOPORE\DATA\CLAY.SMP

LP Analysis Time: 6/2/98 3:52:14PM
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Correction Type: Formula
Show Neg. Int: No

Summary Report

Penetrometer parameters

Penetrometer:	779 - (09) 5 Bulb, 1.131 Stem, Solid		
Pen. Constant:	21.630 µL/pF	Pen. Weight:	62.3792 g
Stem Volume:	1.1310 mL	Max. Head Pressure:	4.4500 psia
Pen. Volume:	6.7595 mL	Assembly Weight:	140.3901 g

Hg Parameters

Adv. Contact Angle:	130.000 degrees	Rec. Contact Angle:	130.000 degrees
Hg Surface Tension:	485.000 dynes/cm	Hg Density:	13.5335 g/mL

User Parameters

Param 1: 0.000 Param 2: 0.000 Param 3: 0.000

Low Pressure:

Evacuation Pressure: 50 µmHg
Evacuation Time: 5 mins
Mercury Filling Pressure: 1.59 psia
Equilibration Time: 10 secs

High Pressure:

Equilibration Time: 10 secs

Blank Correction by Formula

Intrusion Data Summary

Total Intrusion Volume =	0.1821	mL/g
Total Pore Area =	12.041	m²/g
Median Pore Diameter (Volume) =	0.5588	µm
Median Pore Diameter (Area) =	0.0054	µm
Average Pore Diameter (4V/A) =	0.0605	µm
Bulk Density at 0.10 psia =	1.8328	g/mL
Apparent (skeletal) Density =	2.7514	g/mL
Porosity =	33.3843	%
Stem Volume Used =	33	%

Mayer Stowe Summary

Mayer Stowe Summary

Interstitial porosity =	33.3843	%
Breakthrough pressure ratio =	6.2723	