

Analytical Report FR1002301		Mercury Porosimetry of certified Silica-Alumina reference material Micromeritics P/N004/16822/00	
Issue No:	1	Issue Date:	10 th February 2010
Rev No:	2	Revision Date:	27 th April 2010
Approved by Technical Director EFMG:		G.P. Matthews	



**Mercury Porosimetry of certified Silica-Alumina reference material
Micromeritics P/N004/16822/00**

Prepared For:

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Customer Requirements

Dr Mike Foulkes from the University of Plymouth, required mercury porosimetry undertaken for 1 Silica-Alumina reference material.

All work was performed as agreed in quotation and worksheet FJ1002301.

Methodology

The Silica-Alumina reference material was sent by the University of Plymouth to the Environmental and Fluid Modelling Group facility for analysis. No preparation was required for the silica-alumina reference material prior to analysis. The porosimetry was performed following the standard operating procedures for the Micromeritics AutoPore III porosimeter found in the record manual.

The sample upon arrival was Silica-Alumina reference material Micromeritics P/N004/16822/00. This sample was labelled using the Environmental and Fluid Modelling Group's sample labelling system:

Certified Silica-Alumina reference material Micromeritics P/N004/16822/00 = 02100001

The samples were analysed using a Micromeritics AutoPore III 9420 mercury porosimeter which covers the pore diameter range from approximately 360 to 0.003 μm . The AutoPore III measures the volume distribution of pores in materials by mercury intrusion or extrusion. Mercury has a high surface tension and is non-wetting to all materials with the exception of a few noble metals. These properties cause a mercury surface in contact with a solid to assume the minimum surface area, hence largest possible radius of curvature at a given pressure. An increase in pressure on the mercury shifts the balance between surface tension and surface area toward a smaller radius of mercury curvature. When the radius is equal to that of a pore entrance, mercury fills the volume within the pore.

The Laplace equation relates the diameter of the pore (d), with the pressure (P), interfacial tension (γ) and mercury contact angle (θ).

$$d = \frac{-4\gamma\cos\theta}{P} \quad (1)$$

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The Laplace equation can be simplified to equation 2 when the mercury / solid / vacuum interfacial tension is assumed to be 0.485 N m⁻¹ (485 dynes cm⁻¹) and the mercury contact angle is 130 degrees.

$$d = \frac{213}{P} \quad (2)$$

Results

Key Sample Information

Sample ID	02100001
Sample Information	Certified Silica-Alumina Reference Material Micromeritics P/N004/16822/00
Sample Weight (g)	0.9462
Uncorrected Porosity (%)	67.8093
Skeletal Density (g cm ⁻³)	3.6209

02100001 Results – Certified Silica-Alumina reference material Micromeritics

Pressure (Mpa)	Diameter (µm)	cumulative Hg volume (cm ³)	cumulative Hg volume/sample weight (cm ³ /g)	diameter (µm)	slope (cm ³ /g)
3.82E-03	3.85E+02	0.00E+00	0.00E+00		
1.44E-02	1.02E+02	1.74E-02	1.83E-02	1.98E+02	3.18E-02
2.13E-02	6.90E+01	1.91E-02	2.01E-02	8.38E+01	1.07E-02
2.82E-02	5.21E+01	1.98E-02	2.09E-02	6.00E+01	6.24E-03
3.84E-02	3.83E+01	2.04E-02	2.16E-02	4.47E+01	5.08E-03
4.18E-02	3.52E+01	2.05E-02	2.17E-02	3.67E+01	3.26E-03
5.22E-02	2.82E+01	2.08E-02	2.19E-02	3.15E+01	2.51E-03
5.91E-02	2.49E+01	2.08E-02	2.20E-02	2.65E+01	1.48E-03
7.28E-02	2.02E+01	2.11E-02	2.23E-02	2.24E+01	3.09E-03
8.99E-02	1.64E+01	2.13E-02	2.25E-02	1.82E+01	1.75E-03
1.11E-01	1.33E+01	2.16E-02	2.28E-02	1.48E+01	3.58E-03
1.24E-01	1.18E+01	2.15E-02	2.27E-02	1.26E+01	-7.86E-04
1.38E-01	1.07E+01	2.15E-02	2.27E-02	1.12E+01	0.00E+00
1.55E-01	9.48E+00	2.19E-02	2.31E-02	1.01E+01	7.05E-03
1.72E-01	8.53E+00	2.20E-02	2.33E-02	8.99E+00	3.51E-03
1.89E-01	7.76E+00	2.20E-02	2.33E-02	8.14E+00	0.00E+00
2.07E-01	7.11E+00	2.18E-02	2.31E-02	7.43E+00	-5.28E-03

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2.08E-01	7.09E+00	2.18E-02	2.31E-02
2.57E-01	5.73E+00	2.13E-02	2.25E-02
2.91E-01	5.05E+00	2.09E-02	2.21E-02
3.51E-01	4.18E+00	2.05E-02	2.17E-02
4.18E-01	3.52E+00	2.02E-02	2.13E-02
5.19E-01	2.83E+00	1.99E-02	2.10E-02
6.21E-01	2.37E+00	1.96E-02	2.08E-02
8.00E-01	1.84E+00	1.94E-02	2.05E-02
9.64E-01	1.53E+00	1.93E-02	2.04E-02
1.21E+00	1.21E+00	1.91E-02	2.02E-02
1.37E+00	1.08E+00	1.90E-02	2.01E-02
1.52E+00	9.67E-01	1.90E-02	2.00E-02
1.87E+00	7.89E-01	1.90E-02	2.01E-02
2.27E+00	6.47E-01	1.92E-02	2.03E-02
2.58E+00	5.70E-01	1.92E-02	2.03E-02
2.89E+00	5.08E-01	1.94E-02	2.05E-02
3.58E+00	4.11E-01	1.95E-02	2.06E-02
4.40E+00	3.34E-01	1.98E-02	2.09E-02
5.52E+00	2.66E-01	2.02E-02	2.13E-02
6.82E+00	2.16E-01	2.06E-02	2.18E-02
8.31E+00	1.77E-01	2.11E-02	2.23E-02
1.04E+01	1.42E-01	2.17E-02	2.29E-02
1.31E+01	1.12E-01	2.25E-02	2.38E-02
1.63E+01	9.05E-02	2.35E-02	2.48E-02
1.99E+01	7.38E-02	2.47E-02	2.61E-02
2.47E+01	5.95E-02	2.68E-02	2.83E-02
3.09E+01	4.76E-02	2.86E-02	3.03E-02
3.84E+01	3.83E-02	3.16E-02	3.34E-02
4.73E+01	3.11E-02	3.50E-02	3.70E-02
5.91E+01	2.49E-02	3.87E-02	4.09E-02
7.27E+01	2.02E-02	4.38E-02	4.63E-02
9.06E+01	1.62E-02	5.03E-02	5.32E-02
1.13E+02	1.31E-02	5.92E-02	6.26E-02
1.37E+02	1.07E-02	7.12E-02	7.52E-02
1.72E+02	8.57E-03	3.45E-01	3.64E-01
2.06E+02	7.14E-03	5.06E-01	5.35E-01
2.40E+02	6.12E-03	5.32E-01	5.62E-01
2.75E+02	5.35E-03	5.41E-01	5.71E-01

7.10E+00	0.00E+00
6.37E+00	-6.47E-03
5.38E+00	-7.31E-03
4.60E+00	-4.88E-03
3.84E+00	-4.75E-03
3.16E+00	-2.98E-03
2.59E+00	-3.59E-03
2.09E+00	-2.53E-03
1.67E+00	-1.48E-03
1.36E+00	-1.21E-03
1.14E+00	-2.27E-03
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2.98E-01	4.05E-03
2.40E-01	4.79E-03
1.95E-01	6.50E-03
1.58E-01	6.57E-03
1.26E-01	8.66E-03
1.01E-01	1.07E-02
8.17E-02	1.39E-02
6.62E-02	2.43E-02
5.32E-02	1.98E-02
4.27E-02	3.28E-02
3.45E-02	4.01E-02
2.78E-02	4.11E-02
2.24E-02	5.88E-02
1.81E-02	7.29E-02
1.46E-02	9.92E-02
1.18E-02	1.47E-01
9.58E-03	2.97E+00
7.82E-03	2.15E+00
6.61E-03	4.04E-01
5.72E-03	1.63E-01

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3.09E+02	4.76E-03	5.44E-01	5.75E-01
3.26E+02	4.51E-03	5.45E-01	5.76E-01
3.43E+02	4.29E-03	5.47E-01	5.78E-01
3.61E+02	4.08E-03	5.48E-01	5.79E-01
3.77E+02	3.90E-03	5.48E-01	5.80E-01
3.96E+02	3.72E-03	5.50E-01	5.81E-01
4.12E+02	3.57E-03	5.50E-01	5.82E-01
3.91E+02	3.76E-03	5.51E-01	5.83E-01
3.65E+02	4.03E-03	5.52E-01	5.84E-01
3.42E+02	4.30E-03	5.53E-01	5.84E-01
3.18E+02	4.62E-03	5.53E-01	5.85E-01
2.45E+02	6.00E-03	5.52E-01	5.84E-01
1.89E+02	7.79E-03	5.51E-01	5.82E-01
1.45E+02	1.01E-02	5.47E-01	5.78E-01
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2.29E+01	6.43E-02	1.98E-01	2.09E-01
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1.38E+01	1.06E-01	1.73E-01	1.83E-01
1.04E+01	1.42E-01	1.65E-01	1.75E-01
8.31E+00	1.77E-01	1.60E-01	1.69E-01
6.23E+00	2.36E-01	1.49E-01	1.58E-01
4.83E+00	3.05E-01	1.47E-01	1.55E-01
3.44E+00	4.28E-01	1.43E-01	1.51E-01
2.76E+00	5.34E-01	1.37E-01	1.45E-01
2.03E+00	7.24E-01	1.34E-01	1.41E-01
1.66E+00	8.87E-01	1.30E-01	1.37E-01
1.30E+00	1.13E+00	1.25E-01	1.32E-01
9.94E-01	1.48E+00	1.23E-01	1.30E-01
7.58E-01	1.94E+00	1.19E-01	1.26E-01
5.80E-01	2.54E+00	1.15E-01	1.22E-01
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3.34E-01	4.41E+00	1.10E-01	1.16E-01
1.98E-01	7.43E+00	1.06E-01	1.12E-01

5.04E-03	6.47E-02
4.63E-03	6.91E-02
4.40E-03	5.73E-02
4.18E-03	5.11E-02
3.98E-03	4.71E-02
3.81E-03	7.48E-02
3.64E-03	3.33E-02

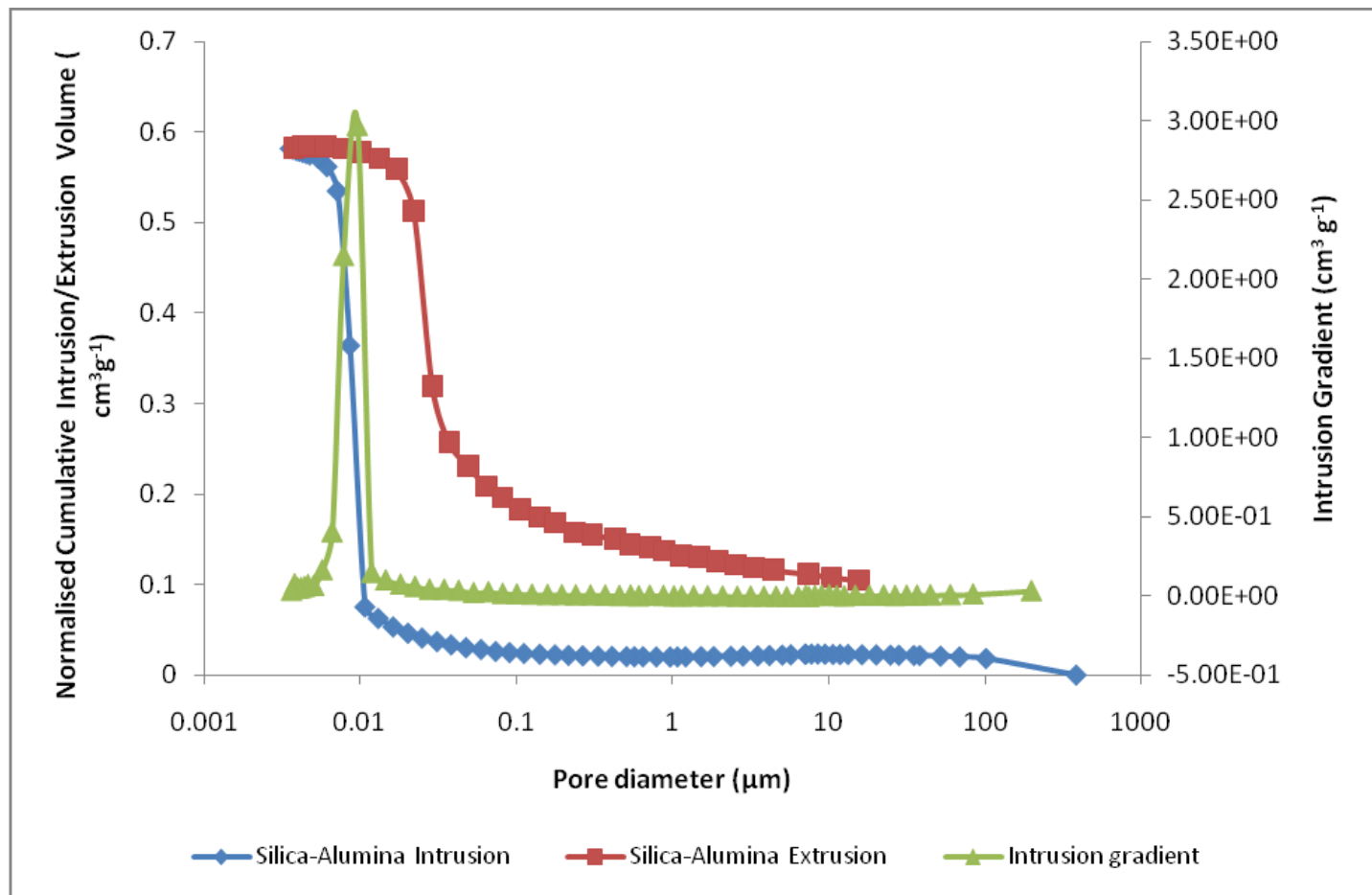
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1.41E-01	1.04E+01	1.03E-01	1.08E-01	
9.43E-02	1.56E+01	9.91E-02	1.05E-01	

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02100001 Mercury Intrusion/Extrusion Graph – certified Silica-Alumina reference material Micromeritics



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Signed on behalf of Technical Director EFMG

G.P. Matthews

Date 27th April 2010

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