MIC SAS® II 5800

SUB-SIEVE AUTOSIZER

micromeritics®

Effective Solutions for
Material Characterization

CALCULATIONS

June 2019

CORPORATE PROFILE

Micromeritics Instrument Corporation is a leading global provider of solutions for material characterization with best-in-class instrumentation and application expertise in five core areas: density; surface area and porosity; particle size and shape; powder characterization; and catalyst characterization and process development. Founded in 1962, the company is headquartered in Norcross, Georgia, USA and has more than 300 employees worldwide. With a fully integrated operation that extends from a world class scientific knowledge base through to in-house manufacture, Micromeritics delivers an extensive range of high-performance products for academic research and industrial problem-solving. The implementation of tactical partnerships to incubate and deliver valuable new technologies exemplifies the company's holistic, customer-centric approach which extends to a cost-efficient contract testing laboratory – the Particle Testing Authority (PTA). The strategic acquisitions of Freeman Technology Ltd and Process Integral Development S.L. (PID Eng & Tech) reflect an ongoing commitment to optimized, integrated solutions in the industrially vital areas of powders and catalysis.

Freeman Technology (Tewkesbury, UK) brings market-leading powder characterization technology to Micromeritics' existing portfolio of particle characterization techniques. The result is a suite of products that directly supports efforts to understand and engineer particle properties to meet powder performance targets. With over 15 years of experience in powder testing, Freeman Technology specializes in systems for measuring the flow properties of powders. In combination with detailed application know-how these systems deliver unrivalled insight into powder behavior supporting development, formulation, scale-up, processing and manufacture across a wide range of industrial sectors.

PID Eng & Tech (Madrid, Spain) complements Micromeritics' renowned offering for catalyst characterization with technology for the measurement and optimization of catalytic activity, with a product range that extends to both standard and bespoke pilot scale equipment. Launched in 2003, PID Eng & Tech is a leading provider of automated, modular microreactor systems for the detailed investigation of reaction kinetics and yield. These products are supported by a highly skilled multidisciplinary team of engineers with in-depth expertise in the design, construction and operation of laboratory units and process scale-up.

The Particle Testing Authority (PTA) provides material characterization services for fine powders and solid materials using Micromeritics' instrumentation alongside complementary solutions from other vendors. With the certification and expertise to operate across a wide range of industries the PTA offering runs from single sample analysis to complex method development, method validation, new product assessment, and the analytical support required for large scale manufacturing projects. An experienced, highly trained team of scientists, engineers, and lab technicians works closely with every client to ensure that all analytical requirements are rapidly and responsively addressed.

Micromeritics has a strong global network with offices across the Americas, Asia, and Europe complemented by a dedicated team of distributors in additional locations. This ensures that local, knowledgeable support is available for every customer, in academia or industry. Micromeritics works across a truly diverse range of industries from oil processing, petrochemicals and catalysts, to food and pharmaceuticals, and at the forefront of characterization technology for next generation materials such as graphene, metal-organic-frameworks, nanocatalysts, and zeolites. Engineering solutions that work optimally for every user is a defining characteristic of the company.

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PARTICLE SIZE

The Kozeny-Carman equation relates pressure drop through a packed bed of solids to the size of the particles in the bed.

$$D = \frac{3}{7} \times 10^4 \sqrt{\frac{L^2 \mu m^2 \rho f}{\Delta P (LA\rho - m)^3}}$$

where

D	=	particle size in µm
L	=	piston height in cm
μ	=	viscosity of air in g/cm·s
m	=	sample mass in g
ρ	=	sample density in g/cm^3
ΔP	=	pressure drop across the sample in cm H_2O
A	=	cross-sectional area of sample tube in cm^2
f	=	volumetric flow rate in cm^3/minute

POROSITY

Porosity is the fraction of the tube volume not occupied by sample. It varies with piston position.

$$P = 1 - \frac{V_{\text{sample}}}{V_{\text{cell}}} = 1 - \frac{m}{\rho L A}$$

where

m	=	sample mass
ρ	=	absolute density
L	=	piston height
A	=	cross-sectional area of the tube

SURFACE AREA

Specific surface area is

$$A/m = A/\rho V = 6/\rho D$$

assuming spherical particles. This equation gives area in m^2/g for density in cm^3/g and size in µm. Multiply by 10^4 to get area in cm^2/g.

VISCOSITY

For many gases, viscosity as a function of temperature is described well by Sutherland's equation.

$$\mu = \mu_0 \frac{T_0 + T_s}{T + T_s} \left(\frac{T}{T_0} \right)^{3/2}$$

For air, $\mu_0 = 1.827 \times 10^{-4} \mathrm{g/cm \cdot s}, T_0 = 291.15\,\mathrm{K}, T_s = 120\,\mathrm{K}$

At 20 °C, $\mu = 1.837 \times 10^{-4} \mathrm{g/cm \cdot s}$