

Saturn DigiSizer® 5200

High Resolution Laser Particle Size Analyzer

 **micromeritics®**
Saturn DigiSizer 5200
High Definition Digital Particle Size Analyzer

 **micromeritics®**
The Science and Technology of Small Particles™

High Resolution, Reproducible Results

Saturn DigiSizer 5200

Major Advance in Particle Sizing Technology

Particle sizing techniques have advanced significantly throughout the past several decades. One of the most important contributions to this field is the application of laser-based technologies, complemented by the use of modern photodetectors and digital computers.

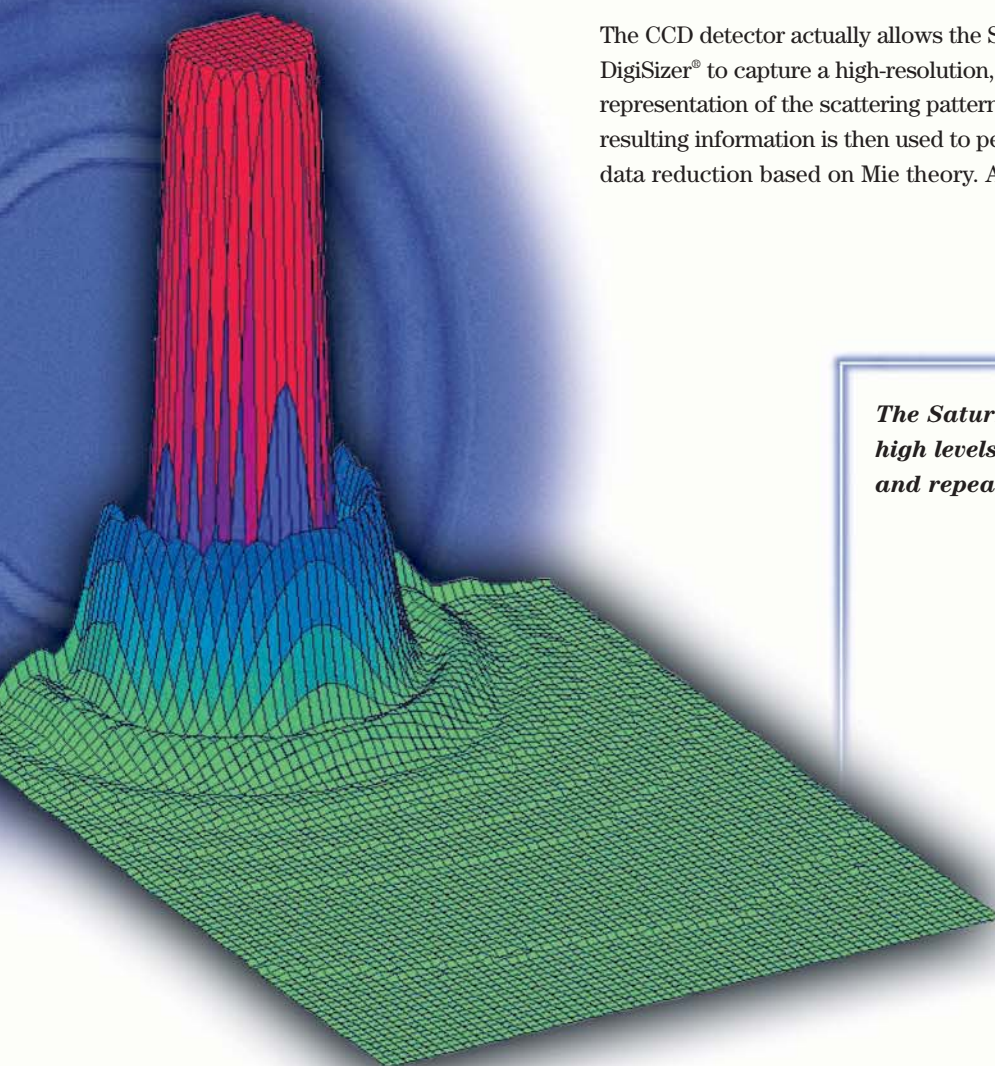
For some time, progress in laser light scattering technology has led to faster analyses, but was limited in the quality of the measurement obtained, often due to inadequacies in the detector.

Recognizing this need for better detection capability, Micromeritics has developed laser light scattering instrumentation that employs a laser diode and a modern charge-coupled device (CCD) detector for the best possible combination of available technology.

The CCD detector actually allows the Saturn DigiSizer® to capture a high-resolution, digital representation of the scattering pattern. The resulting information is then used to perform data reduction based on Mie theory. All of

this is completely automated to ensure the highest possible throughput and corresponding productivity.

The Saturn DigiSizer provides exceptionally high levels of resolution, accuracy, reproducibility, and repeatability. The extremely high-quality experimental data obtained by the Saturn DigiSizer enable the extraction of reliable information from the light scattering pattern.



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Absolute Confidence

Whether you are involved in research, product development, quality standards development, or high-tech production, the Saturn DigiSizer provides highly detailed, accurate results without sacrificing speed of analysis. At every step of the way, the Saturn DigiSizer provides outstanding performance on a wide range of sample types



No technical training or special skills are required. Simply pour the powder into the reservoir and the Saturn DigiSizer will do the rest: dispersion, dilution, initiation of the analysis, reporting of results, and rinsing.

and applications. Advanced automated sample feeding and dispersion features assure that each sample is prepared in the same manner from one analysis to the next.

The complex nature of many types of small particles has until now made it difficult to provide data that can be reproduced from one location (or even one instrument) to the next. For the first time, using the Saturn DigiSizer, analysts can measure the same material on multiple instruments located at different locations around the world and get the same, highly detailed size distribution measurement on each instrument.

Applications

Pharmaceuticals – Particle size plays a major role in the ability to process, blend, tablet, and package a drug substance. The useful shelf life and dissolution rate (governing how rapidly the medicine becomes available to the body) depend upon the particle size of the material.

Ceramics – Particle size information helps to determine curing and bonding procedures, control pore structure, ensure adequate green body strength, and produce a final product of desired strength, texture, appearance, and density.

Catalysts – Flow properties of fluid-cracking catalysts depend upon the particle size distribution of the particles. Surface area and pore structure of acid catalysts and catalyst supports result from the particle size distribution of the particles that are used to produce them.

Paints & Coatings – The particle size distribution of the pigment or filler influences the porosity, gloss, texture, color, color saturation, brightness, solids content, and film adhesion properties. The resulting porosity can control application properties such as fluidity, drying or setting time, and film thickness.

Cosmetics – The appearance, application, and packaging of cosmetics are influenced by the particle size distribution of the base powders, such as talc, and the pigments used for coloring.

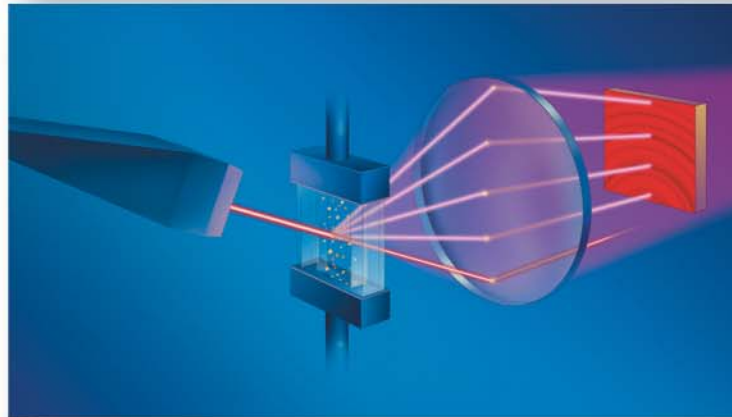
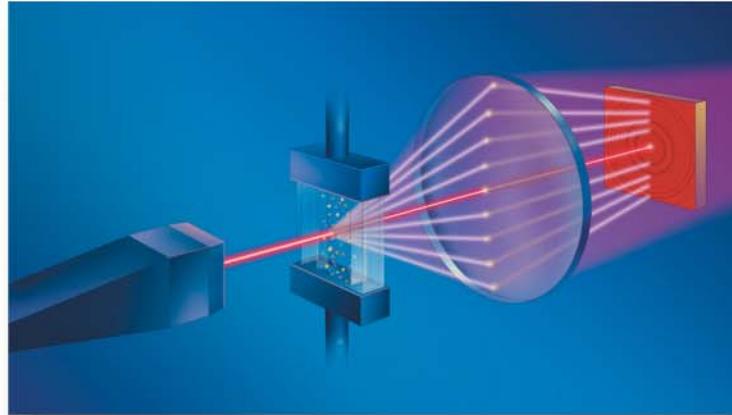


New Approach to Particle Sizing

Micromeritics' Revolutionary Patented Optical Design

CCDs were originally developed for the high-sensitivity and high-resolution requirements of imaging for astronomy. Using a Micromeritics patented CCD-based detector, the Saturn DigiSizer captures the scattering pattern produced during analysis. The Saturn DigiSizer CCD captures a high-definition digital representation of the scattering pattern, which contains all of the information required to determine the particle size distribution that formed the scattering pattern.

Micromeritics' application of the CCD to the Saturn DigiSizer eliminates the need for mechanical fine-tuning of optical alignment. The instrument is automatically aligned by re-mapping the CCD array so that the scattering angle assigned to each element is exact to less than 0.005 degree relative to the central, unscattered light beam. The Saturn DigiSizer's CCD array has more than 1.3 million detector elements for each five-degree segment of scattering angle. The resulting extremely high resolution makes it possible to detect subtle differences in scattering patterns, and therefore subtle differences in particle size distributions. These minute differences in sample particle size may indicate a manufacturing variance, corroborate or refute theoretical studies, or help explain natural processes. Put simply, higher resolution means greater knowledge about differences between your samples.



Advanced design features enable the Saturn DigiSizer to measure a light scattering pattern over a broad range of scattering angles with a dynamic intensity range from 1 to 1×10^{10} . Combined with the high angular resolution of the CCD, the detector system provides an effective resolution of several million pixels at different positions in the scattering pattern, each detecting minute variations in light intensity. The Saturn DigiSizer's high resolution enables the instrument to detect extremely small variations in the scattering pattern that are not detected by lower resolution instruments. It is this high level of accuracy that allows the Saturn DigiSizer to provide more detailed and precise particle size information than laser diffraction particle sizing systems of conventional design.



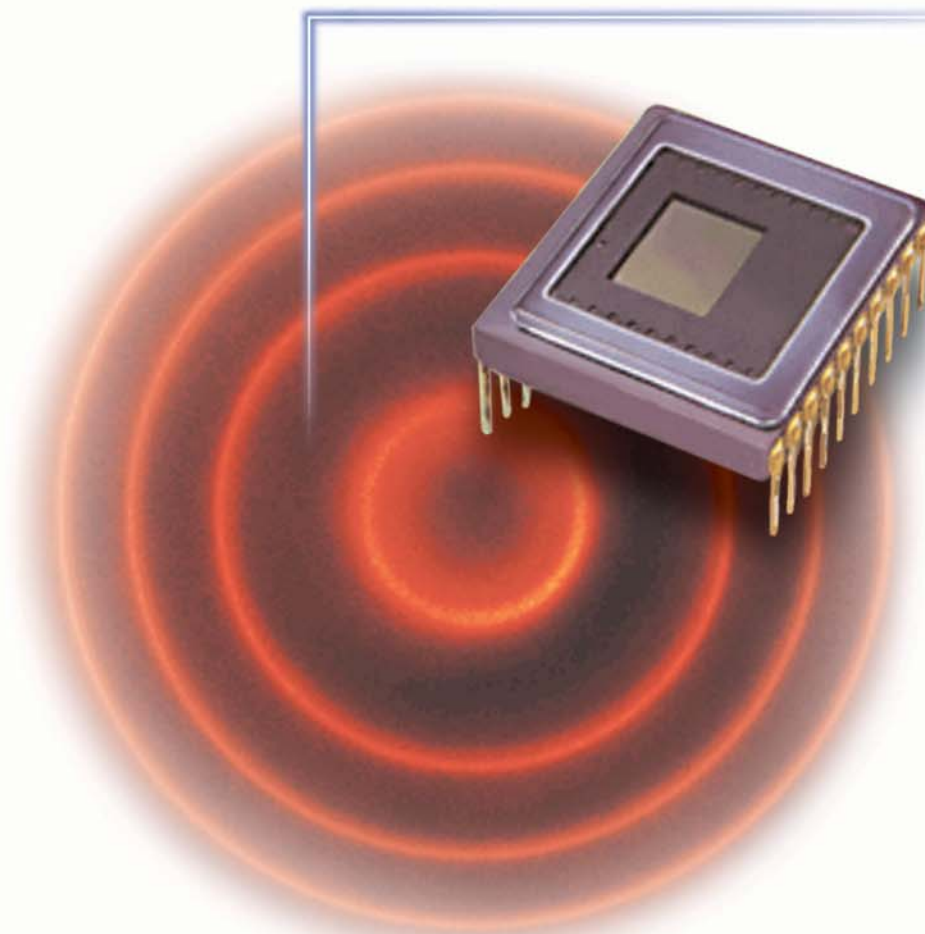
Micromeritics' New Approach to an Old Technique

Theories concerning the relationship between an assemblage of particles and the pattern of light it scattered were proposed in the 1800's, mathematically unified by Mie in 1908, and eloquently summarized by van de Hulst in 1957. By the early 1970's laser light scattering particle sizing instruments were becoming commercially available. A major problem with this technique, even up until today, has been the lack of agreement between analyses of the same sample material by instruments from different manufacturers, and even between different models produced by the same manufacturer.

This is primarily because of measurement of too few data points in the scattering pattern and the inadequate attempts to compensate for low resolution and other shortcomings using software-based algorithms.

Micromeritics has taken a new and more effective design approach to measuring the scattering pattern. Rather than use a photodiode array to capture average light intensity readings over extended regions of the scattering pattern, the Saturn DigiSizer uses a high-resolution CCD array in a stepwise manner to capture a true digital representation of the scattering pattern—not simply the 50- or 100-light measurements within the pattern as taken with non-digital techniques.

With this high-resolution, closely spaced array of data, the intensity versus angle plot of data is practically continuous. Thus, Mie theory can be applied directly, without compensation algorithms and without concern over whether the distribution is mono-modal or multi-modal. The quality of the Saturn DigiSizer analysis is apparent upon overlaying the angle versus intensity plot of experimental data from an analysis of a reference material (or a mixture of different size reference materials) with the angle versus intensity plot of data calculated from Mie theory for the reference size(s). Such a comparison is a standard report provided by the Saturn DigiSizer.



The Saturn DigiSizer uses a high-resolution CCD array in a stepwise manner to capture a true digital representation of the scattering pattern.

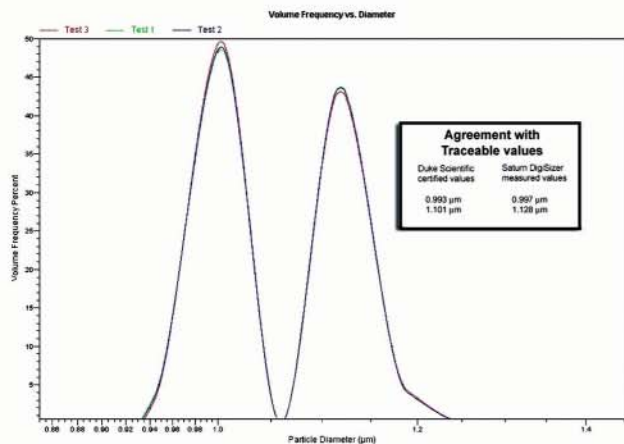
Data Presentation Made Easy

The Saturn DigiSizer's powerful, easy-to-use and versatile user interface puts you in command of the analysis. It provides all the convenient features you expect from a Windows®-based program such as point-and-click menus, multitasking capability, copy to clipboard, and more. The familiar Windows format reduces the time required for training and eliminates the need for most off-line data manipulation, resulting in increased productivity.

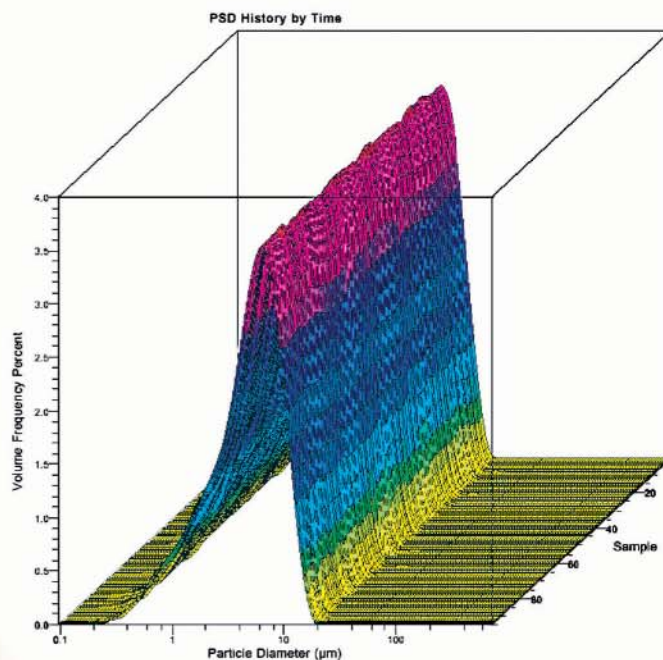
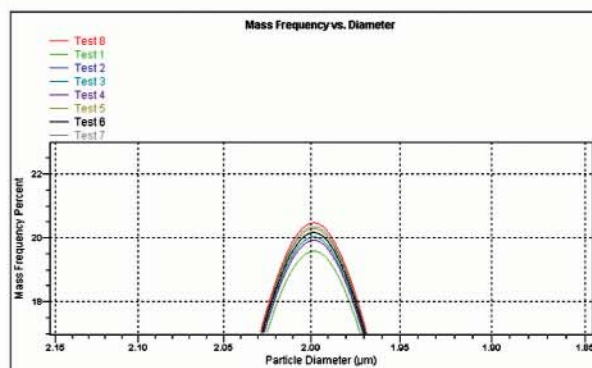
A wide range of data presentation options is available with the Saturn DigiSizer. With many instruments that employ the static light scattering technique, a final report of reduced data typically is the only output available. The Saturn DigiSizer, however, allows you to access the raw data. For instance, an image of the scattering pattern (2-D and 3-D representations) can be displayed, or you can receive a 465-point intensity versus angle data report in tabular

or graphical form. To allow a quick assessment of the fit of theoretical models to experimental data, you also can obtain an overlay plot of measured data and data calculated from Mie theory.

This magnified view of the frequency plot of a 2- μm material demonstrates the remarkable repeatability of the Saturn DigiSizer.



This is an analysis of two narrow-distribution latex microspheres which differ in size by only 10%. Notice the baseline resolution.



This PSD History chart of 95 analyses of garnet from 31 different instruments illustrates the repeatability and resolution of the Saturn DigiSizer.

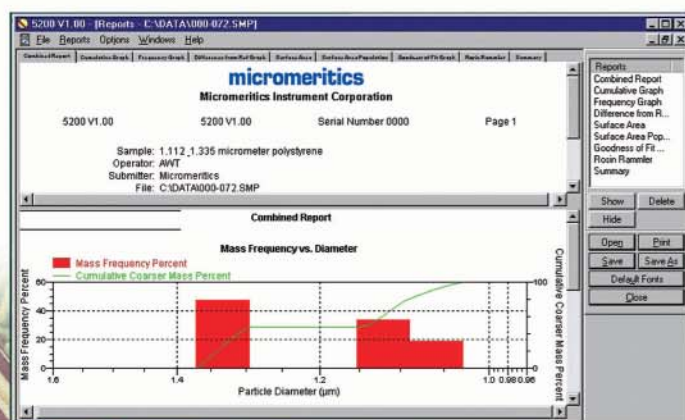
Reduction of Raw Data Based on a Firm Theoretical Basis (Mie Theory) Ensures Exceptional Data Quality

Micromeritics employs the Mie theory (or the operator can choose to use Fraunhofer for particles that are both large and opaque) to reduce experimental data. These theories describe light scattering via theoretical models. No modifications to the theory are made with the Saturn DigiSizer, and no assumptions of modality or distribution type are used. This is made possible by the remarkably high resolution of the optical system allowing very narrow size classes to be used in fitting the data to Mie theory.

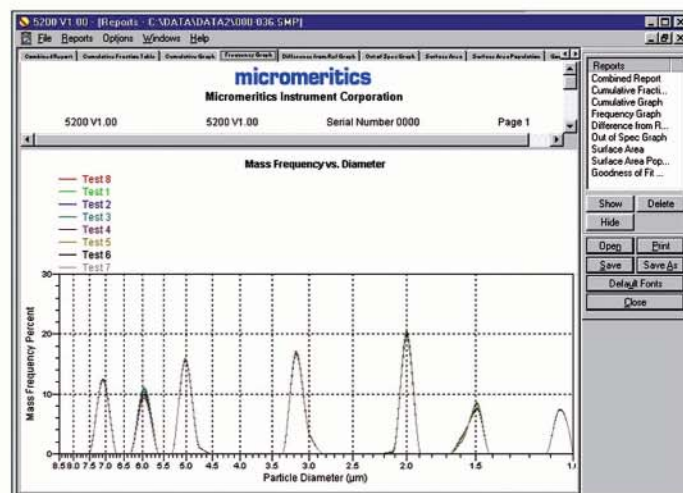
The application of Mie theory provides unambiguous size data and this is what the Saturn DigiSizer will report for you. What's more, you will be presented with a plot that shows how well experimental measurements compare with theoretical Mie calculations for the scattering pattern from the reported distribution.



This Goodness of Fit graph of a 3.12- μ m latex standard shows the agreement between the calculated PSD and the measured light scattering data.



Typical histogram of a mixture of 1.112- and 1.335- μ m latex standards with a cumulative overlay.



This repeat analysis of a blend of latex standards demonstrates the size resolution and repeatability of the calculated distribution.

Accessories

The Saturn DigiSizer 5200 System includes many options that allow you to tailor the instrument according to your specific needs. Multiple sample dispersion system options, an automatic sampler, and a device for removing dissolved gases from the suspension liquid are available to contribute to the versatility of the system. These options are all designed and manufactured with the same care and attention to detail that produced the Saturn DigiSizer.



Liquid Sample Handling Units (LSHU)

The Saturn DigiSizer's sample handling units ensure that every sample will be correctly dispersed. Micromeritics' patented, state-of-the-art liquid sample handling units work with the instrument software to assure that sample suspension is of the proper concentration.

A continuous flow through the reservoir provides a mixing action sufficient to keep all sample material suspended and prevents the settling of particles. An optional ultrasonic probe aids in liquid dispersion of agglomerates which may occur in samples such as dry process materials. The Saturn DigiSizer's LSHU ensures consistent, sample-to-sample results.

To reduce the possibility of sample carryover between analyses, the standard LSHU has a patented reservoir rinse design. While other designs simply fill and empty the reservoir to rinse, the Saturn DigiSizer's standard LSHU has a feature that sprays the reservoir walls as the fluid level recedes. This removes residue that otherwise could cling to the surface.



Liquid Sample Handling Unit systems used with the Saturn DigiSizer are available in two configurations, a standard version and a low-volume version. In addition, a micro-volume option is available with either LSHU version. Micromeritics can easily assist you in deciding which system is right for your needs.

Standard Volume Liquid Sample Handling System

The standard LSHU requires 500 – 600 mL of liquid to carry the sample with a circulation pump rate of 6 – 15 L per minute. The high flow rate better supports particles that have an inherently higher settling velocity. In addition, the unique centrifugal pump design helps to avoid attrition of the particles during circulation.

Applications:

- Coarse particles
- High-density particles
- Quantity of sample, liquid supply and/or waste disposal is not a problem
- Large sample volumes are desired for better sampling statistics

Low-Volume Liquid Sample Handling System

The low-volume LSHU requires only 100 mL of liquid to carry the sample with a circulation pump rate of 2 – 12 L per minute. It can circulate particles of up to 750 μm depending on the density of the particle and type of suspension liquid.



AquaPrep™

When using water as a suspension liquid during particle size analysis, it is possible for atmospheric gases to come out of solution forming minute bubbles that may become incorporated with the sample dispersion. This has a disruptive effect on particle size analysis because the bubbles circulate through the measurement zone of the analyzer and are detected as if they were particles. This can result in the reporting of particle size classes that are not actually present. Removing these bubbles is a requirement for obtaining the most accurate particle size data, particularly when using a highly sensitive analyzer like the Saturn DigiSizer.

Micromeritics' AquaPrep solves this problem by recirculating water through a hydrophobic capsule consisting of many thin-walled capillaries. A vacuum pump provides low pressure on the outside of the capillaries. The result is a diffusion of dissolved air from the water through the capillary walls and removal through the vacuum pump.

The AquaPrep can prepare 10 liters of water in less than 2 hours (at standard temperature and pressure) and ensures that you are getting the most accurate representation possible of the particle size distribution in your sample.

Use of the low-volume system reduces cost by requiring smaller amounts of liquid and sample, and also reduces the expense of waste disposal.

Applications:

- Sample quantity is limited or sample material is expensive
- Supply of dispersion liquid is limited and/or expensive
- Dispersion liquid is hazardous to use and/or presents disposal problems

Micro-Volume Option

This option is available with either the standard or low-volume LSHU. The micro-volume option requires only 7 mL of liquid to carry the sample. The sample dispersion is static and non-pumped.

Applications:

- Extremely expensive or rare samples
- Sample dispersions requiring expensive or hazardous liquid
- Samples with particles that settle less than 1 cm in 5 minutes
- Fragile samples that may easily be damaged or reduced in size by pumping

MasterTech™ Autosampler

The MasterTech Autosampler provides assurance that samples are prepared and analyzed exactly the same way, every time. The MasterTech is designed to increase throughput, repeatability, and reproducibility while reducing operator involvement. Up to



18 samples can be queued to run sequentially and completely unattended, including automatic stirring or sonication prior to transfer to the analysis system. The Saturn DigiSizer's operating software controls the MasterTech, and information about dispersion is stored in the sample file for future reference.

The MasterTech features a powerful ultrasonic probe for sample dispersion. Power to the probe tip is adjustable and the driving circuit is self-tuning for maintaining efficient and consistent sonic energy levels. A front-panel digital readout lets you know when the desired power is reached, and that same power is applied each time the method is repeated.



The Science and Technology of Small Particles™

Micromeritics Instrument Corporation
One Micromeritics Drive
Norcross, GA 30093-1877
USA

Telephones:

Domestic Sales (770) 662-3633
International Sales (770) 662-3660
Customer Orders (770) 662-3636
Fax (770) 662-3696

Micromeritics China
Apt. 5H, No. 1 Building
Hua-Ao (Epoch) Center
No. 31 Zi Zhu Yuan Road
Hai Dian District
Beijing 100089
P.R. CHINA

Telephone (+86) (0)10-6848-9371
Fax (+86) (0)10-6848-9371

Micromeritics France
181, rue Henri Bessemer
F-60100 Creil
FRANCE

Telephone (+33) (0)3-4464-6080
Fax (+33) (0)3-4464-6089

Micromeritics GmbH
Erftstrasse 54
D-41238 Mönchengladbach
GERMANY

Telephone (+49) (0)2166-98708-0
Fax (+49) (0)2166-98708-88

Micromeritics Ltd.
Unit 2, Chestnut House
178-182 High Street North
Dunstable, Bedfordshire LU6 1AT
ENGLAND

Telephone (+44) (0)1582-475248
Fax (+44) (0)1582-475252

Micromeritics N.V./S.A.
Eugene Plaskylaan 140B
1030 Brussels
BELGIUM

Telephone (+32) (0)2-743-39-74
Fax (+32) (0)2-743-39-79

Micromeritics SRL
Via W. Tobagi n. 26/7
20068 Peschiera Borromeo
Milano
ITALY

Telephone (+39) (0)2 553 02833
Fax (+39) (0)2 553 02843