

CILAS

PARTICLE SIZE AND SHAPE ANALYSIS

BUILDING MATERIALS

SOILS AND SEDIMENTS

PAINTS, INKS, LACQUERS

GLASS AND CERAMICS

HOME AND PERSONAL CARE

PHARMACEUTICALS

FOOD AND BEVERAGES

GRAPHITE AND CARBON BLACKS

POLYMERS AND METALS



APPLICATIONS



BUILDING MATERIALS

- cements
- calcium carbonate
- fly ash
- sands



SOILS AND SEDIMENTS

- clays
- fine sediments
- coarse minerals



GLASS AND CERAMICS

- silica
- all ceramics
- granulates



HOME AND PERSONAL CARE

- colour and effect pigments
- cream ingredients



FOOD AND BEVERAGES

- milk products
- spices
- coffee powder



GRAPHITE, CARBON BLACKS AND OILS



PAINTS, INKS, LACQUERS

- organic and inorganic lacquers
- toner
- inks



PHARMACEUTICALS

- active ingredients in powders or granulates
- emulsified systems



POLYMERS AND METALS

- metal powders
- polymer powders

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Since more than 20 years **QUANTACHROME** stands for comprehensive characterisation of dispersions, powders and porous materials in Europe. In the business area **DISPERSIONS** the aim is to offer a technical competent consulting and measurement solution to users from research, development and quality control for their powder- and dispersion characterization. In our focus are determinations of important parameters like particle size distribution, stability of dispersions, colloidal properties of liquid systems like zeta potential, microrheology and film formation and - finally - the validation of these informations.

INSTRUMENT ENGINEERING

QUANTACHROME DISPERSIONS offers instruments for the characterisation of DISPERSIONS, EMULSIONS and PARTICLES:



- dynamic light scattering for particle size measurements in diluted dispersions
- acoustic attenuation spectrometry for particle size analyse in concentrated dispersions
- static light scattering for particle size measurements in diluted dispersions and dry particles
- image analysis systems for particle size and shape analysis in dispersions and of dry particles
- multiple light scattering and transmission to measure stability in dispersions
- electroacoustic spectrometry for zeta potential analysis in concentrated dispersions
- diffusing wave spectroscopy to determine the microrheology and film formation of dispersions

ANALYTICS AND RESEARCH

Our constant growing laboratory (LabSPA - Laboratory for Scientific Particle Analysis) offers SERVICES as follow:



- comprehensive characterisation of dispersions, powders and porous materials
- high quality services for commercial analysis, method development and project work at scientific level
- functioning on the basis of quality management
- qualified consulting for questions regarding results or used methods

CONSULTING AND SERVICE

One of our key aim is to provide our clients **OPTIMAL CONSULTING** and **SERVICE**:



- competent application consulting before and after acquisition of a measurement device
- professional training and device installation
- professional device service on-site, flexible service contracts on demand
- by request permanent information about laboratory experiences (application and or device technology) by means of newsletters, application notes or the **QUANTACHROME** journal Particle WORLD
- further education seminars about analysis methods and applications



THE LATEST CILAS GRANULOMETER DEVICE GENERATION



TRADITION IN LASER TECHNOLOGY:

Since more than 40 years CILAS is developing innovative products in the area of optics and laser technology. The first really successful commercial laser diffraction device CILAS 715 entered the market in 1970. Since the hard- and software of the instruments were developed continuously with regard to the demands of the market, the actual CILAS devices are very user-friendly, reliable and powerful products for particle size analyse in development and quality control.

EASY HANDLING AT HARD- AND SOFTWARE

Thanks to the very easy handling of the software SIZE EXPERT even inexperienced users can achieve really good results. The measurement cell and the complete sample dispersing system can be serviced and cleaned trouble-free due to the very clear arranged and good accessible hardware components. The switching from wet to dry dispersion (combi-devices type -LD) is achieved just by an easy mouse click (no hardware backfitting).

OPTICAL MEASUREMENT SYSTEM FOR HIGHEST REPRODUCIBILITY

The patented optical bench of all CILAS devices is consisting of an insusceptible to shock, forged basis with a short optical path. Thus no mirror deflection or mobile parts are integrated to avoid maladjustment-effects. This - in combination with a precise laserdiode-technology - guaranties a highest possible reproducibility and stability of the measurement technique. CILAS particle size measurements devices are characterised by highest reliability and robustness - e.g. for quality control and incoming inspection.

FULL INTEGRATED IMAGE ANALYSIS SYSTEM

For many applications the visual inspection of the samples is important for the evaluation of the measurement results - e.g. in case of presence of agglomerates. Further shape parameters are a crucial quality criterion for some applications. Thus CILAS has developed the first laser granulometer with full integrated image analysis system - the EXPERT SHAPE: with this technique, the same sample can be characterised with both methods - static light diffraction and image analysis.

THE CILAS GRANULOMETER PRODUCT LINE



CILAS 990

quality control in the standard measurement range

The CILAS 990 is equipped with a high precision 830 nm laser diode and thus predestinated for high accuracy and reproducibility in the standard measurement range (0.2 - 500 μm). It is the standard device for many applications like building materials, ceramics, metals, polymers or paints.

- optionally equipped with wet- and/or dry-dispersion - switch by mouse click (software)
- robust optical bench without moving parts
- simultaneous measurement of particle size and shape (with option EXPERT SHAPE)
- sufficient representative sample amount for wet dispersion thanks to standard bath size of about 400 ml and 1 mm gap measuring cell



CILAS 1090

highest precision in the fine size area

This instrument is equipped with a laser diode dual technique (830 and 635 nm) and offers all benefits of the CILAS 990. Furthermore it offers the possibility to characterise very fine samples (up to 0,02 μm) with highest precision.

- optionally equipped with wet- and/or dry-dispersion - switch by mouse click (software)
- robust optical bench without moving parts
- simultaneous measurement of particle size and shape (with option EXPERT SHAPE)
- sufficient representative sample amount for wet dispersion thanks to standard bath size of about 400 ml and 1 mm gap measuring cell



CILAS 1190

high end for a wide application also for coarse grains

The CILAS 1190 is equipped with a patented multi laser technique (2 units 830 and 635 nm) and a special CCD camera technique. Thereby it additionally offers (in comparison to the CILAS 1090) the possibility to measure coarse particles (up to 2500 μm) with high precision. Even coarse granulates, sands or fillers can be characterised.

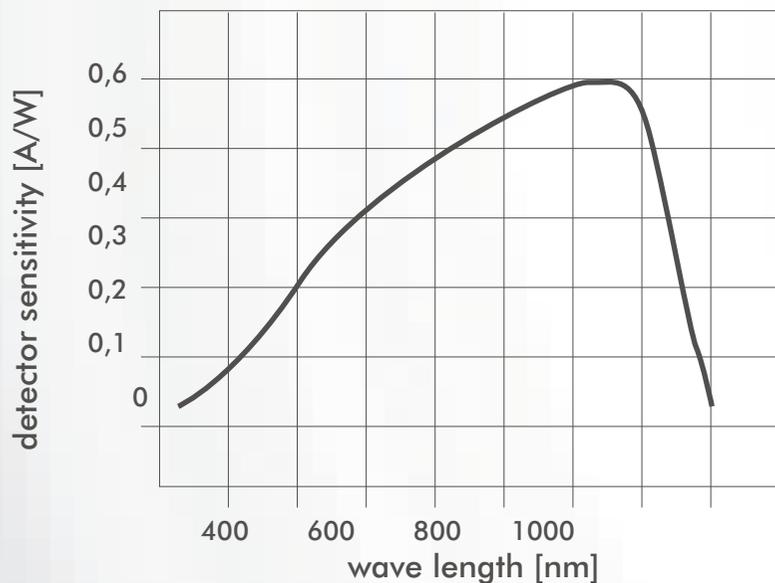
- optionally equipped with wet- and/or dry-dispersion - switch by mouse click (software)
- robust optical bench without moving parts
- simultaneous measurement of particle size and shape (with option EXPERT SHAPE)
- optimal preciseness for coarse particles due to the combination and exploitation of the benefits of the two techniques "laser diffraction" and "image analysis"

LASER TECHNOLOGY

LASER DIODE TECHNIQUE:

CILAS measurement devices of the actual line (CILAS 990, CILAS 1090 and CILAS 1190) are equipped with tempered laser diodes. For a interference-free transfer the diodes are adapted to a monomode fiber light conducting cable. In contrast to a HeNe-laser these diodes are using a solid semi-conducting material as active laser medium which has the following advantages:

- a higher life time than HeNe laser (statistically about 4 times higher)
- a much more precise wave length characteristic and thus a narrower emission spectrum than LEDs (2-3 nm FWHM in contrast to about 50 nm (FWHM = Full Width at half maximum))
- possibility of an electric pulsing and with it the abandonment on rotating aperture plates (disturbing scattering effects at the edges)



LASER WAVELENGTH:

All CILAS devices are equipped with a diode laser with the wavelength of 830 nm, because the silicium photocells used as detectors have the highest light sensitivity between 800-1000 nm. On the other hand laser with a shorter wavelength are necessary for more precise measurements for particles $< 1 \mu\text{m}$. Summarised the 830 nm laser is most suitable for measurements in the coarser size range ($> 800 \text{ nm}$).

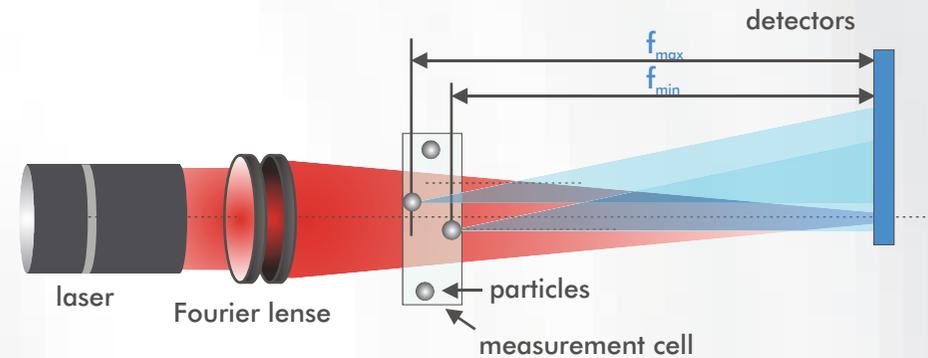
The instruments CILAS 1090 and CILAS 1190 are equipped with two electric clocked lasers - 830 nm and 635 nm. This setup enables the additional characterisation of very small particles ($<< 1 \mu\text{m}$) due to the shorter wavelength of the second laser.

DEVICE PERFORMANCE

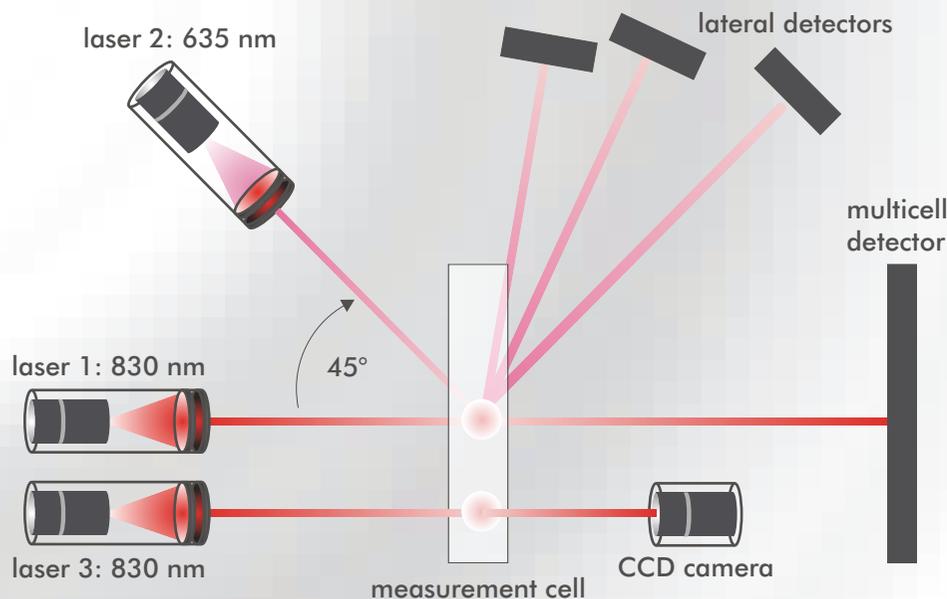
INVERSE FOURIER OPTICS WITH NARROW CELL GAP:

CILAS measurement devices have a **inverse Fourier set-up**: thus the Fourier lens is positioned directly behind the laser diode and is focusing the light in the detector plane. The advantages are that first the measurement of the scattered light is also possible at larger angles and, second that very small particles can be measured. On the other hand this set-up bears the challenge to bring the particles **approximately in one layer** to achieve the highest possible accuracy. The reason is, that in a convergent beam the size of the scatter diagram depends on the distance of the particles to the detector.

In principle the accuracy (G) in (%) is the deviation from the ideal situation "all particles in one layer". G is defined as the relation of the difference of the maximal (f_{max}) and minimal (f_{min}) focal length - limited by the gap of the measurement cell - and the mean focal length (f) to the detector. A cell with a gap of 1 mm for instance enables a 4 times higher accuracy than one with a 4 mm gap. Thus, in case of grinding processes slight variations of the particle size can be detected much more sensitive. For this reason CILAS offers for instance customised devices for production control with a preferably narrow gap but for the application sufficient measurement range.



$$G = (f_{max} + f_{min}) \cdot 100 / f$$



OPTICAL BENCH:

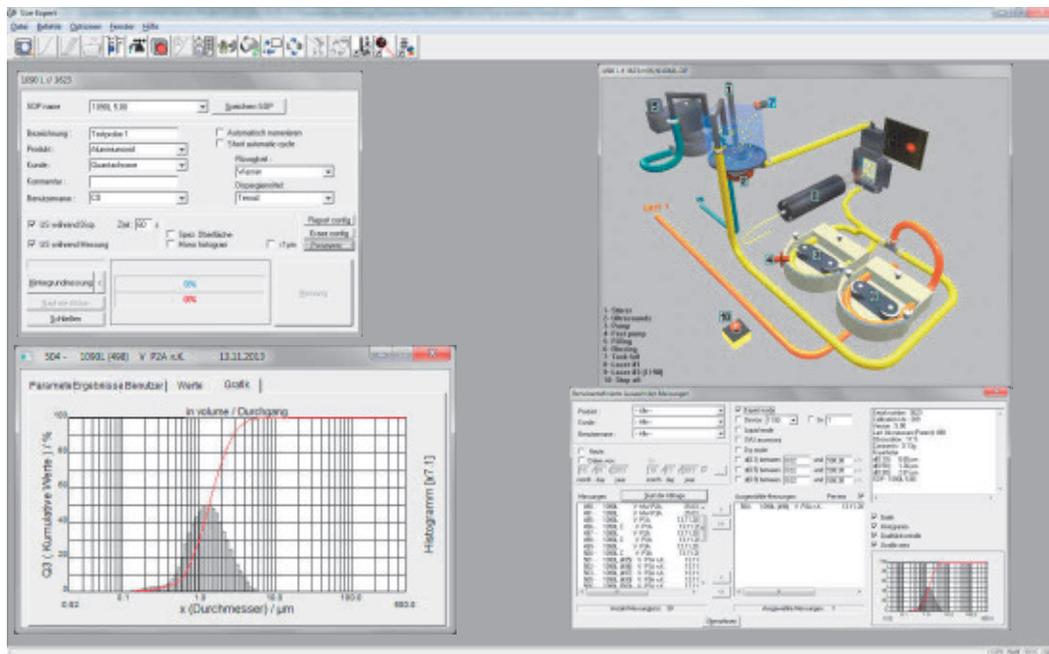
In order to achieve an accurate and repeatable result using the static light, a suitable optical bench, composed of light source, measurement cell and detectors is absolutely required.

For all CILAS devices the optical bench consists of an insusceptible to shock, forged basis with relatively short, optical ways and without deflection by mirrors. On the one hand this set-up is limiting the measurement range to coarser particles with scatter diagram analysis. On the other hand it guaranties a very high reproducibility and particulare stability of the measurement technique due to prevention of negative effects on the optical path (readjustment of the position of mirrors or apertures).

The extention of the measurement range to 2500 μm (CILAS 1190) is realised using an image analysis system. Thus the CILAS 1190 line is combining the advantages of both analysis methods - static light scattering and image analysis - and can measure with this short, stable optical bench.

SOFTWARE SIZE EXPERT

The correct handling of the software SIZE EXPERT can be easily learned by everybody because it is designed and enhanced basically to more than 40 years of experience in different applications of quality and production control as well as in development. In the real time modus the dispersion characteristics of unknown samples can be monitored live and the measurement conditions can be optimised (ultrasound treatment, additives etc.). The measurements of known materials occur fully automated by means of standard operation procedures (SOPs). SIZE EXPERT is working on the basis of a modern data base and enables an automatic data backup in a network. For the data documentation measurement reports can be created easily. The data export of selected values or complete measurements can be executed by simple mouse click.



PROPERTIES AND PREFERENCES:

- simple handling with clean menu display and icon bar
- multilingual Software (German, English, French, Spanish, Portuguese, Italian, Polish, Czech)
- determination of the optimal measurement conditions in real time modus with block diagram
- fast and automatic measurements with standard operation proedures (SOPs)
- direct switch from wet to dry dispersion without hardware rebuilding
- fast creation of clear reports
- fast data export (ASCII, Excel) via mouse click
- integrated data base with comprehensive search functions
- automatic data backup
- clear presentation of the measurement results in individual windows
- implemented analysis theories according to Fraunhofer and Mie with direct conversion between both models and pilot tool to determine the optical constants
- compliance with ISO 13320, 21 CFR-Part 11

SPECIAL FEATURES:

- distribution functions: volume, surface, number, monomodal, lognormal, Rosin Rammler (LR-, GLR- and NM-method)
- calculation of the specific surface from the size distribution
- overlay function with statistic analysis (mean value, standard deviation, mix function)
- air separator analysis with real and reduced tromp curve
- evaluation of individual particle fractions

WET DISPERSION - BASIS MODULE

The wet dispersion unit (basis module) is designed in the manner, that a visible sample preparation (dispersion) can be done by means of a stirrer and ultrasound treatment, before the samples reaches the measuring cycle. Optional a high-energy ultrasound dispersion bar can be used in the bath. The well-tried peristaltic pump technique enables a gentle feeding of the sample to the measurement cell. The bath volume is drafted for an optimal, representative sample measurement.



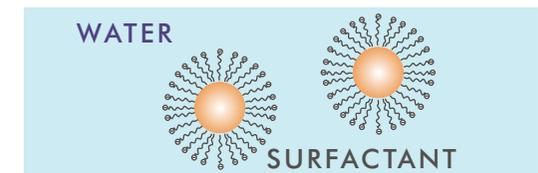
PROPERTIES AND PREFERENCES:

- sample volume 250 - 400 ml
- ultra sound: up to 50 watt using the ultrasonic bath; up to 200 watt using the additional ultrasound bar
- particle size: 20 nm to 2500 μm (depending on device configuration)
- variable pump speed (30 - 360 rpm) and stirrer speed (0 - 550 rpm)
- suitable for aqueous, polar and non polar solvents
- very easy handling to carry out a measurement
- excellent dispersion before and during the measurement (for re-agglomerating samples)
- very easy to clean due to a very good accessible system
- very cost-saving exchange of the tubes in case of contaminating samples
- very simple switch from wet to dry dispersion via mouse click in case of combined devices (LD-systems)
- very high reproducibility of the measurement

MECHANISM OF THE WET DISPERSION

1. WETTING:

A basic requirement for a successful wet dispersion of a powder is a good wetting of the used liquid. In case of a hydrophobic material that is not wettable by water one can use either a surfactant or a (non-)polar organic solvent.

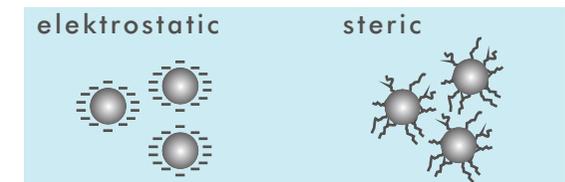


2. PARTICLE SEPARATION:

In liquids a mechanical separation by means of stirrers, dissolvers or mills can be applied. Alternatively or additionally ultrasonic dispersion systems can be used.

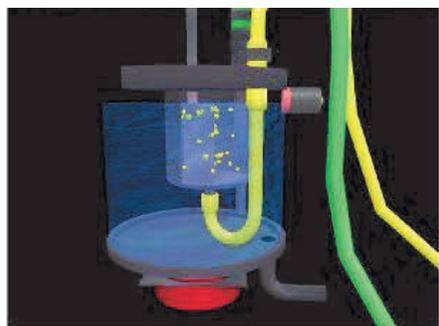
3. PARTICLE STABILISATION

First of all it's important, that the particles don't dissolve in the liquid! Insoluble materials can be stabilised electrostatic or steric.



INTEGRATED SMALL VOLUME CELL

The CILAS small volume unit is designed for reproducible measurements of smallest sample amounts. The unit is - regarding to hard- and software - completely integrated in the wet dispersion system of the CILAS devices. The switch from normal to small-volume is fast and easy. Comparable to the normal-volume dispersion unit, a visible sample preparation by means of a stirrer and supersonic sounding is possible (without direct sample feeding to the measurement cell). The sample transport also occurs by means of peristaltic pumps.



PROPERTIES:

- sample volume 45 - 90 ml
- ultrasound up to 50 watt bath sounding
- particle size: 20 nm to 600 μm (depending on device type and sample material)
- variable pump speed (30 - 360 rpm) and stirrer speed (0 - 550 rpm)
- applicable for aqueous, polar and non polar solvents
- very easy handling to execute a measurement
- excellent dispersion before and during the measurement (important for samples which tend to reagglomeration)
- easy to clean and good accessible system
- easy exchange of the tubes in case of contaminating samples
- very simple change from wet- to dry dispersion via mouse click in the software in case of combined devices (LD-systems)
- high reproducibility of the measurements

EXTERNAL SMALL VOLUME CELL

The external small volume cell is perfect suited for reproducible particle size measurement in polar and non polar solvents. The consumption of solvent is very small due to the small amount of liquid. Further the system is excellent applicable for hard dispersible dispersions and those which tend to re-agglomeration due to its effective and controllable sonotrode.

The cleaning and the change of solvent is easy to do due to the quick fastener. The sample feeding to the CILAS static light scattering device occurs by means of a solvent resistant tube and is controlled manually.



PROPERTIES:

- sample volume ca. 90 - 120 ml
- stainless steel agitator vessel with centrifugal pump and quick fastener
- ultrasound power: up to 200 watt; frequency: 26 kHz - adjustable amplitude (20 - 100 %) - programming of the maximal application of energy touch display, automatic data storage and remote control
- particle size: 20 nm to 2500 μm (depending on device type and sample material)
- manually infinitely variable stirrer speed
- applicable for aqueous, polar and non polar solvents
- very easy handling to execute a measurement
- excellent dispersion before and during the measurement (important for samples which tend to reagglomeration)
- easy to clean and good accessible system
- easy exchange of the tubes in case of contaminating samples

DRY DISPERSION

The dry dispersion unit of the CILAS devices is equipped with a special vibration feeder: the sample will be predispersed and fed to a drop shaft, which leads to a vertical, dry air flow. The measurement pressure (and thus the dispersion) is software-controlled by the venturi nozzle. The software-controlled sample vibration feeder has an auto modus (controlled by detected light intensity) to optimise the introduced amount of sample during the measurement routine.

For very coarse powders (> ca. 600 μm) the feeding and dispersion of the sample occurs by vibration feeder and drop shaft only.

The high and constant sample throughput and thus a large representative sample amount is a significant advantage of dry in comparison to wet dispersion. Furthermore materials like coffee or special salts can only be stabilised and measured in liquids with high expenditure. Here again, the dry dispersion is preferred for most of these applications.



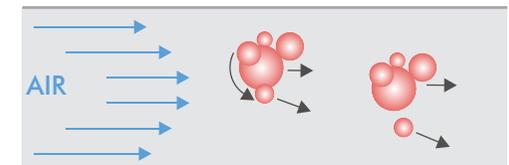
PROPERTIES:

- sample amount: a few grams - depending on the material
- particle size: 0.1 bis 2500 μm (depending on the device type)
- variable sample feeding (vibration frequency: 5 - 80 Hz; intensity: 5 - 90 %)
- variable air pressure: 0 - 6000 mbar
- very easy handling to execute a measurement - especially due to the automatic sample amount control
- very easy to clean
- very good access to the complete system for possible user maintenance
- very simple switch from wet to dry dispersion via mouse click in case of combined devices (LD-systems)
- very high reproducibility of the measurement

MECHANISM OF THE DRY DISPERSION

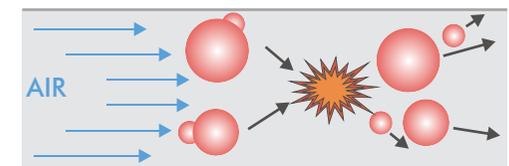
1. PARTICLE SHEARING:

Agglomerates get into rotation and translation movement when they enter the air flow. Thus centrifugal and shear forces act on the particles which can lead to the breakup of agglomerate bindings.



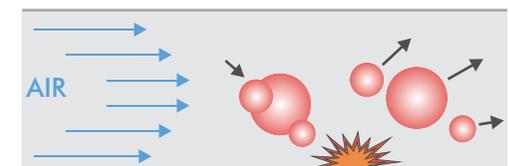
2. PARTICLE-PARTICLE IMPACTS:

Depending on the air pressure the agglomerates have a high kinetic energy, collide with each other and the individual particles of the agglomerate separate.



3. PARTICLE-WALL IMPACTS:

Particle-wall impacts are the energetic strongest dispersion effects in case of dry dispersion. However the risk of a real particle grinding is high - especially for brittle materials.



EXPERT SHAPE VIDEO SYSTEM

The EXPERT SHAPE VIDEO SYSTEM is the ideal measurement device for users who need additional information about the sample as:

- determination of different shape properties of samples (such as roughness of mechanical polish etc.)
- size measurement of anisotropic particles (such as fibre length, fibre diameter etc.)
- search for agglomerates, oversized particles and their number



The measurement system consists of an optical microscope with a variable objective lens and a measurement flow cell which is linked to the measurement circuit of the CILAS-L device. Dispersion and pumping of the sample is realised automatically using the hardware of the CILAS-L laser diffraction analyser. In liquid mode pictures of the sample were taken software controlled and automated. Alternative particles can be dispersed dry on a microscope slide manually or by means of a dry disperser. This slide can be positioned on the two axis object-plate instead of the flow cell. In this case the pictures of the sample will be taken manually. The image editing, object labeling and classification of all individual particles are carried out using the image analysis software EXPERT SHAPE.

SPECIFICATION:

particle size range	0,5 μm - 2500 μm (standard range 1,0 μm - 300 μm)						
particle size parameters	circle equivalent diameter; feret diameter; perimeter; geodesic length (fibre length); fibre thickness; disk with same perimeter; sphere equivalent volume; area and more						
particle shape parameters	aspect ratio; compactness; extension; area porosity; Waddel's circularity; equivalent ellipse parameters; fibre curl; rectangle ratio; convex hull area; convexity; solidity; circularity; Heywood circularity factor; circularity ratio; sphericity; moment of inertia parameters and more						
dispersion mode	wet measurement in automatic mode (ultrasound, stirrer); dry measurement in manual mode						
optical system	light source: halogen lamp 6 V - 30 W; detector system: CCD; microscope: inversed system with different resolutions						
camera system	pixel number: 768 X 576 - CCIR; pixel size 8.6 μm (H) X 8.3 μm (V); size of sensor: 1/2"; 12 V - DC						
lenses (resolution)	magnification	X1.25	X4	X10	X20	X40	X100
	resolution $\mu\text{m}/\text{pixel}$	12.16	3.8	1.5	0.9	0.45	0.15
dimensions	L = 205 mm, B = 555 mm, H = 500 mm						
weight	10,7 kg						

AUTOSAMPLER

Der AUTOSAMPLER LD is the new benchmark of dry- and wet measurement with static light scattering for laboratory applications. The robot system is characterised by:

- automatically pick up of up to 30 powders (dry or wet measurement) or dispersions (wet measurement)
- programmable shaking (dry and wet measurement) and rinsing (wet measurement) for a complete sampling to the CILAS measurement device
- very easy handling and robustness



SPECIFICATION:

properties	4-axis robot system; robust and reliable; easy to handle; suitable for fully automated wet and dry measurement
sample management	30 sample vials on two levels; maximum sample weight 30 g per vial; multiple vial feeding for larger sample amounts possible
dispersion	liquid and dry dispersion (compatible with L&D systems); integrated rinsing steps between samples to avoid contamination; user specific dispersion additive system
robot precision	better than 200 μm Software via SIZE EXPERT with user friendly interface and SOP-management for individual vials
compatibility	systems 990/1090/1190 with new electronic and new liquid dispersion unit (please contact info@quantachrome.de)
power supply	100 to 240 V, 50/60 Hz (maximal: 1 A with 220 V/ 2 A with 110 V)
dimension	length/height/depth: 812 mm X 790 mm X 595 mm height with black hose cover: 1128 mm with CILAS device: length height depth: 112 mm X 790 mm X 595 m
weight	25 kg

AUTOMATIC RECYCLING UNIT A.R.U.

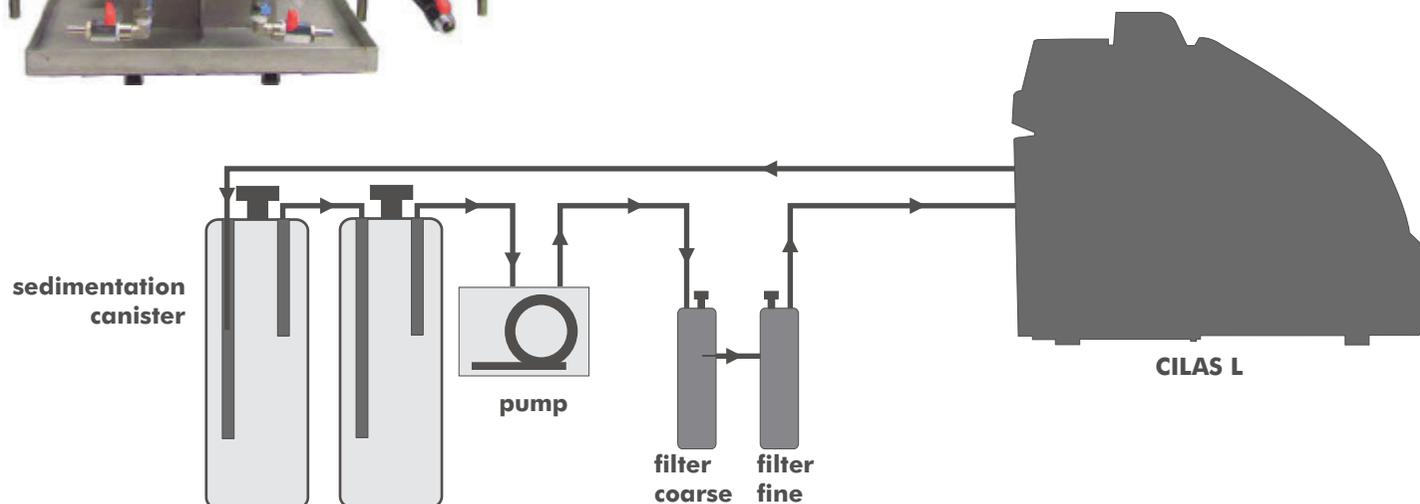
The AUTOMATIC RECYCLING UNIT (A.R.U.) is ideal for users who must measure in an alternative solvent than water and have a high sample throughput. This is applicable for samples which are soluble or incompatible with water. The dispersion medium will be recycled automatically within a closed circle after the measurement instead of disposing. The A.R.U. is characterised by:

- a four-step recycling with two sedimentation canisters and two filter units
- the fully automatic and software controlled operation by means of SIZE EXPERT
- a very easy, fast and user friendly handling
- a high cost-benefit ratio at simultaneously environmental friendliness



SPECIFICATION:

liquid volume	45 l (2 X 20 l canister volume plus 5 l filter and pump volume)
filter effect	depending on the used filter cartridge and sample
compatibility	water; alcohols; oils; petrols (heptanes) and more...
dispersion	liquid
device compatibility	all CILAS wet systems (type "L")
size	canister (2 pieces): height: 780 mm; diameter: 200 mm filter unit: length height depth: 400 mm X 370mm X 350 mm
space requirement	length/height/depth: 700 mm X 800 mm X 500
weight	ca. 30 kg
accessory	forged trolley (length depth: 550 mm X 750 mm)



device type	CILAS 990	CILAS 1090	CILAS 1190
PROPERTIES measuring principle analysis size range dry sampling wet sampling time of measurement repeatability accuracy	static light scattering analysis Fraunhofer or Mie 0,3 - 500 μm 0,2 - 500 μm < 1 min < 1 % < 3 %	static light scattering analysis Fraunhofer or Mie 0,1 - 500 μm 0,02 - 500 μm < 1 min < 1 % < 3 %	static light scattering analysis Fraunhofer or Mie 0,1 - 2500 μm 0,02 - 2500 μm < 1 min < 1 % < 3 %
DISPERSION TECHNIQUE dry feeding/dispersion wet feeding/dispersion cuvette	Venturi peristaltic pumps, ultrasonic bath, optional ultrasound dispersion bar quartz glass - 1 mm gap	Venturi peristaltic pumps, ultrasonic bath, optional ultrasound dispersion bar quartz glass - 1 mm gap	Venturi or falling chute peristaltic pumps, ultrasonic bath optional ultrasound dispersion bar quartz glass - 3 mm gap
OPTICAL BENCH lense arrangement number of laser laser type laser power laser safety class cover closed cover open detectors size classes compliance	inverse Fourier optic 1 laser diode 830 nm 5 mW 21 cfr-1040/NF EN 60825-1/A2 class 1 - NF EN 60825-1/A2 class 3 - NF EN 60825-1/A2 silicium Photocell 44 channels 100 ISO 13320, 21 cfr part 11, CE	inverse Fourier optic 2 laser diode 830 nm and 635 nm 5 mW and 2 mW 21 cfr-1040/NF EN 60825-1/A2 class 1 - NF EN 60825-1/A2 class 3 - NF EN 60825-1/A2 silicium Photocell 64 channels 100 ISO 13320, 21 cfr part 11, CE	inverse Fourier optic 3 laser diode 830 nm and 635 nm 5 mW und 2 mW 21 cfr-1040/NF EN 60825-1/A2 class 1 - NF EN 60825-1/A2 class 3 - NF EN 60825-1/A2 silicium Photocell 87 channels 100 ISO 13320, 21 cfr part 11, CE
DIMENSION dimension (L X T X H) weight (-L, -D, -LD) power supply	890 X 530 X 430 mm 55, 48, 61 kg 115V/60 Hz - 230V/50 Hz	890 X 530 X 430 mm 55, 48, 61 kg 115V/60 Hz - 230V/50 Hz	890 X 530 X 430 mm 55, 48, 61 kg 115V/60 Hz - 230V/50 Hz
COMPUTER SPECIFICATION operating system Computer Interface	Windows XP, 7 (32 und 64 bit) RS 232 or USB 2.0	Windows XP, 7 (32 und 64 bit) RS 232 or USB 2.0	Windows XP, 7 (32 und 64 bit) RS 232 or USB 2.0



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