LAB & INDUSTRY EQUIPMENT

BUCH HOLM

Buch & Holm A/S

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FRITSCH

Laser Particle Sizers

IDEAL FOR

- MEASUREMENT OF PARTICLE SIZE DISTRIBUTION OF SUSPENSIONS
- TWO MEASURING RANGES 0.5–1500 µm AND 0.01–3800 µm
- PRODUCTION AND QUALITY CONTROL
- RESEARCH AND DEVELOPMENT

STATIC LIGHT SCATTERING

QUALITY
MADE IN GERMANY

FRITSCH is more than just a brand: It is backed by a strong, medium-sized, family business in its fourth generation, which has been firmly embedded in the region since 1920 and globally active for decades. All FRITSCH-products are produced according to strict quality criteria, and our entire production is in-house. The innovative ideas of our development department are inspired by the close relationship with our customers and their practical work in the lab. Satisfied customers worldwide count on our quality, our experience and our service. This makes us proud and motivates us.

FRITSCH. ONE STEP AHEAD.

ANALYSETTE 22 NeXT
Micro and Nano

Automatic particle size analysis: unbeatably simple

YOUR ADVANTAGES

- **Exactly the measuring range you need**
- **ANALYSETTE 22 NeXT Micro 0.5 – 1500 µm**
- **ANALYSETTE 22 NeXT Nano 0.01 – 3800 µm**
- **Short measuring times, especially high measuring accuracy**
- **Consistent reproducibility, reliable comparability**
- **Solid and low-maintenance with few moving parts**
- **Easy operation, quick and residue-free cleaning**
- **Compact, space-saving design**

With the completely revised ANALYSETTE 22 NeXT you choose according to your requirements: The ANALYSETTE 22 NeXT Micro with a measuring range of 0.5 – 1500 µm for all typical measurement tasks or the high-end instrument ANALYSETTE 22 NeXT Nano with an extra wide measuring range of 0.01 – 3800 µm for maximum precision and sensitivity for smallest particles with an additional detector system.

Get all the decisive advantages with the model that meets your requirements: especially easy operation and cleaning, short analysis times, reliably reproducible results and the recording of additional parameters such as temperature and pH value during wet dispersion. State-of-the-art technology at an unbeatable price. Cleverly made!

Two models for especially efficient particle size analysis – in production and quality control as well as in research and development or for controlling manufacturing processes.

FRITSCH Advantage
Compact design
The intelligently revised measurement design makes the ANALYSETTE 22 NeXT especially compact and space saving.

FRITSCH Advantage
Short measuring time
The ANALYSETTE 22 NeXT completes most measurements in less than one minute – including a reliably residue-free cleaning.

FRITSCH Advantage
Fully automatic analysis
The complete evaluation of the particle size analysis takes place automatically with clearly organised results visible directly on the screen. Of course, you can also save and print out a report customised to your needs.

FRITSCH Advantage
Outstanding support
Following your purchase of an ANALYSETTE 22 NeXT we also offer installation, customising software details and training in Germany – always available, quick and flexible. Worldwide our international representative offices or experts from the FRITSCH headquarters are available via remote maintenance for any help you may need. We do not leave our customers alone.

Easy application for anyone

Laser particle sizing at the push of a button

With the ANALYSETTE 22 NeXT the precise measurement of particle sizes becomes a simple matter – even for employees with brief instructions and no prior knowledge, e.g., in merchandise receipt or shipping departments, where its robust mechanics are an additional advantage. A brief introduction to the instrument is sufficient; the rest runs automatically.

1. START PROCEDURE

To start a measurement with the ANALYSETTE 22 NeXT, simply select one of the predefined Standard Operating Procedures (SOPs, see page 15).

2. ADD SAMPLE

The software sets the necessary instrument parameters automatically and prompts you to add the sample material. As soon as the quantity is sufficient, the measurement starts automatically.

3. COMPLETELY AUTOMATIC PROCEDURE

- Automatic dispersion
- Automatic measurement
- Automatic analysis
- Automatic rinsing
- Automatic report generation

Especially clever – the coloured status display

The current status is indicated to you by respective colours – whether you are filling in sample material, dispersing, measuring or rinsing.

Reliable measuring results

Certified reproducibility

The ISO 13320 (Particle size analysis – Laser diffraction methods) defines as a guideline the minimum standards for Laser Particle Sizers regarding repeatability, reproducibility and measuring precision and thus regulates the verification of the measuring results. The FRITSCH ANALYSETTE 22 NeXT clearly surpasses the requirements of the ISO 13320. Typically FRITSCH.

Reference material for inspecting the measuring system

Reference materials

Particle size determination using laser diffraction is based on fundamental physical principles, meaning that, strictly speaking, calibration of the instruments is not necessary. Nevertheless, the operating mode should be inspected regularly to ensure proper function. Various reference materials are used for this permitting a simple, quick and reliable check of the entire system for different applications and particle size ranges.

The reference materials offered by FRITSCH are delivered along with precise dispersion and measurement instructions and are accompanied by a certificate containing the upper and lower limits of the expected particle sizes. These limit values were determined using an internationally recognised process (NIST-traceable).

The ISO 13320:

- Describes the fundamental measuring principle
- Outlines the possible variants of the optical design (of laser diffraction instruments/particle size analysers)
- Provides criteria for using the suitable light scattering theory (Fraunhofer diffraction or Mie scattering)
- Defines the inspection of the accuracy, reproducibility and repeatability of measuring results
- Offers recommendations for optimising the measuring procedures

Well-conceived measuring technology

Two measuring units for different measuring ranges

The current generation ANALYSETTE 22 NeXT operates like every FRITSCH Laser Particle Sizer to date with the Reverse Fourier design invented by FRITSCH which has established itself by now as a general standard. Your advantage: No additional optical elements are necessary between the measuring cell and detector. The design is compact with as few components as possible and has no moving parts – low wear and practically maintenance-free.

Strong advantages during measurement:

- Only one light source: simple, robust, reliable
- Quick and simultaneous recording of all scattering data
- Highly precise recording of the light intensities by state-of-the-art 16 bit converter technology
- Recording also of very wide scattering angles by intelligent measuring cell design
- Two models available with different measuring ranges
- Continuous logging of the laser output
- Quick, automatic beam adjustment

FRITSCH Advantage

One laser – faster measurement

The ANALYSETTE 22 NeXT operates with only one laser and does not need an additional light source even for backward scattering. Therefore it records the entire measuring range with only one scan. That makes your work significantly faster – you can conduct more measurements in the same time if necessary. And see live how the measuring result develops.

FRITSCH Advantage

Extremely enlarged measuring angle

In the ANALYSETTE 22 NeXT, the measuring cell is set at an angle to the laser beam so that a significantly wider scattering angle range can be recorded as with comparable instruments. That is the decisive difference especially in the nano range.

FRITSCH Advantage

Simultaneous data acquisition

Due to its ultra-modern electronics, whose core are extremely fast, high-resolution converters, the ANALYSETTE 22 NeXT records the signals of all detector elements simultaneously. As a result, it always delivers the entire scattered light distribution at respectively exactly the same time and transmits it several hundred times per second to the software.

FRITSCH Advantage Easy cleaning of the measuring cell

The measuring cell of the ANALYSETTE 22 NeXT is simply inserted from the front as a practical cartridge and can be opened without tools with an eccentric lock. Its cleaning is quite convenient by an easily re-insertable outer seal. And also the exchange of the measuring cell glasses can be done any time completely uncomplicated.

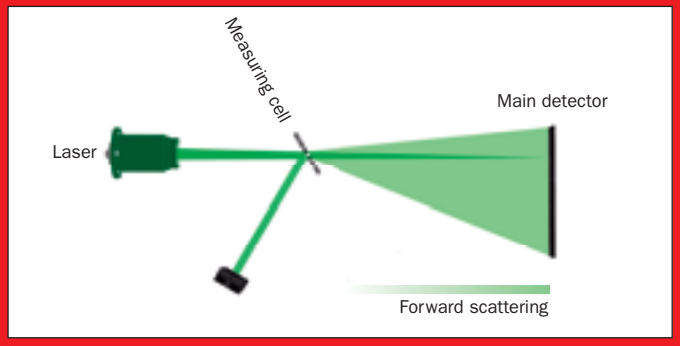
Measuring cell of the ANALYSETTE 22 NeXT with easy to remove outer seal

FRITSCH Advantage

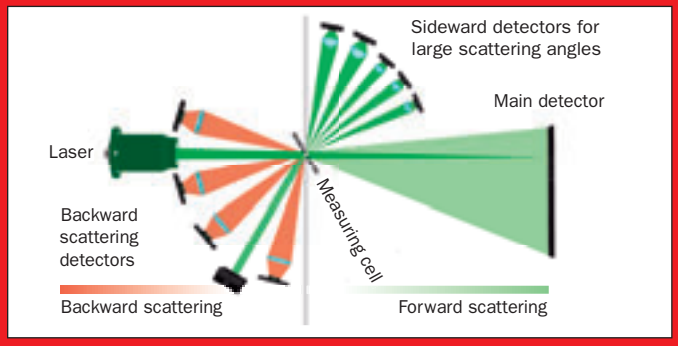
Two models for different measuring ranges

The two models of the ANALYSETTE 22 NeXT differ in design and in measuring range. The ANALYSETTE 22 NeXT Micro, which is reduced to one light source and one detector, measures robustly and reliably from 0.5 to 1500 µm.

The ANALYSETTE 22 NeXT Nano expands the lower measurement value by the intelligent arrangement of an additional detector system. This makes the recording of even larger scattering angles down to 0.01 µm possible in sideward as well as backward direction. The upper measurement limit is increased at the same time to outstanding 3800 µm.



Schematic measurement design ANALYSETTE 22 NeXT Micro



Schematic measurement design ANALYSETTE 22 NeXT Nano

Reliable thoroughness

Perfect FRITSCH wet dispersion

For most samples, wet dispersion represents the ideal method of preparation for particle size measurement. What counts here: Each particle size measurement is only as good as its dispersion. For this reason, we place great importance on this aspect and bring all our experience to bear.
The result: a quite powerful, flexible and modular wet dispersion system.

Strong advantages during dispersion:

- Simple operation
- Compact measuring circuit
- Powerful pump
- Practically maintenance-free design
- Monitoring of the important dispersion parameters
- No dead space in measuring and rinsing circulation system
- Fast and consistent cleaning
- Variable suspension volume between 150 ml and 500 ml
- Many organic solvents can also be used as a standard feature
- Separate ultrasonic box with up to 50 Watt output
- Freely programmable

A powerful centrifugal pump with individually adjustable speed ensures stable measuring in the dispersion unit of the ANALYSETTE 22 NeXT. It also transports heavy particles and facilitates a fast and uniform distribution of the sample material in the entire circulation system. Standard programs for simple operation, freely programmable dispersion process, an especially fast and efficient automatic cleaning and many other advantages also simplify your work. And ensure the quality of your measuring results.

FRITSCH Advantage

Measurement of temperature and pH value

The stability of the suspension is extremely important for the successful dispersion. Therefore you can measure and log the temperature with the dispersion system of the ANALYSETTE 22 NeXT. For additional measurement and logging of the pH value of the liquid, connect a suitable pH meter via USB interface to the ANALYSETTE 22 NeXT and attach a sensor onto the dispersion unit.

FRITSCH Advantage

Separate ultrasonic box

If you measure sample material frequently that tends to agglomerate, you can equip your ANALYSETTE 22 NeXT additionally with a powerful ultrasonic box which is simply inserted into the sample circulation system. It allows for an even finer adjustment of the wet dispersion to the respective sample material and operates extremely quietly with less than 45 dB.

FRITSCH Advantage

Practically maintenance-free

With its cleverly reduced design and solid, robust engineering, we have designed the dispersion unit of the ANALYSETTE 22 NeXT for an especially long service life and practically maintenance-free. Doing completely without valves and moveable seals in the sample circulation system ensures for example that no dead spaces occur and no sample material can accumulate and settle. And the fill level measurement is done without contact using an ultrasonic sensor. Without soiling. Without wear.

FRITSCH Advantage

Illuminated dispersion bath

Ergonomically positioned, the illuminated dispersion bath makes it incredibly easy to feed the sample material and to observe the dispersion process.

FRITSCH Advantage

Continuously variably placeable return pipe

Available only from FRITSCH: The sample material flowing back from the measuring cell is fed into the dispersion bath not at one specified, unchangeable position, but rather through a variably positionable return pipe. With that you can create depending on the sample, a finely adjustable and accurately reproducible swirl effect that keeps the suspension constantly in motion.

Fast, strong cleaning

Work particularly easily with the FRITSCH wet dispersion unit

The efficient, valveless rinsing of the FRITSCH wet dispersion unit utilises the powerful pressure of the pump and thus achieves a fast and thorough cleaning of the dispersion system. A single rinse is sufficient and you can go on directly to the next sample.

FRITSCH Advantage
Easily removable hood

The hood of the FRITSCH wet dispersion unit can be removed quite easily. This makes the complete dispersion bath much more accessible for cleaning than comparable instruments.

FRITSCH Advantage
Dispersion bath without dead space

Available only from FRITSCH: The first fully automatic wet dispersion unit that does not need a clamping or rotation valve for emptying the system. That makes it significantly more robust and virtually wear-free. And there are neither difficult to clean dead spaces in which soiling can get deposited permanently nor seals that can become leaky just by single particles.

Suitable for many liquids!

All parts in the sample circulation system, which come into contact with the dispersion medium are made of high-quality stainless steel 316L, PTFE, BK7 glass, Viton® or silicone and are suitable for use with benzene, alcohol and many organic solvents as suspension liquids.

Resistant against chemicals

If you are working with extremely aggressive chemical dispersion liquids, you can order the wet dispersion unit with the conversion kit Extended for extreme chemical resistance. The kit consists of seals and a flow plate made of FFKM Kalrez® – the hoses are made of LEZ SAN®. Ask us about it! If you already have an instrument, you can order the conversion kit separately at any time to retrofit your equipment. A list providing an overview of chemicals can be downloaded at www.fritsch-international.com/chemicals.

Speaking about water quality

Water is by far the dispersion liquid employed most frequently. Generally normal tap water is perfectly adequate. If, however, the degree of hardness of the water is too high for example or sufficient purity is not ensured, it may be necessary to use treated water. Just ask us – we will be happy to advise you.

FRITSCH Advantage

Easy visible hoses

The hoses made of silicone with especially smooth interior surfaces are hardly susceptible to deposits and make soiling or blockages directly visible. Due to practical cap nuts they can be easily removed and reattached manually without tools for cleaning.

Our suggestion: In case you do not have a suitable media connection at the setup site of the instrument, you can also simply provide the liquid in a container and employ an additional, external pump for filling the dispersion unit. The control of this process is done through the electronics of the dispersion unit and is controlled as usual by the software.

Perfect evaluation – MaS control

For the control, recording and perfect evaluation of your measuring results your ANALYSETTE 22 NeXT is delivered with the FRITSCH MaS control software in which all user entries, parameters and results are saved automatically and revision-proof in an SQL database. And by integration into a local computer network, all measuring data can also be conveniently analysed on other computers.

The facts

- Simple organisation of the measuring data
- Easy to learn due to use of Microsoft Office standard
- Intuitive operation via central navigation area
- All relevant information available at a glance
- Clear comparison of different measurements
- Analysis according to Fraunhofer or Mie theory
- Control of the measuring process via SOPs
- Non-stop recording/logging of temperature and pH value of the dispersion possible
- Individual reports and layouts
- Freely selectable user values issued in table format
- Manual entry of comparison data possible
- Consideration of sieving results
- Data export to Excel™ and in XML format
- SQL database
- 21 CFR part 11 optional
- Multi-lingual user interface

FRITSCH Advantage
Plug and Play due to pre-installed software

We make it very easy for you: The MaS control software comes directly pre-installed and tested on a PC with every ANALYSETTE 22 NeXT measuring unit – including monitor, keyboard and mouse.* Plug it in, start it and off you go!

FRITSCH Advantage
Flexible report generator

In addition to integrated standard reports, the freely editable report generator allows you to organise your measurement reports exactly according to your needs. Graphics as well as all measuring parameters, statistical values or selected measuring values can be incorporated in a report.

*without computer hardware for deliveries to CIS countries

Open configuration of the measuring process – SOPs

The ANALYSETTE 22 NeXT software contains completely predefined Standard Operating Procedures – SOPs for short – for nearly all typical measurement tasks, making operation especially easy. Via a well-arranged input mask, you are completely free and flexible in modifying these SOPs to perfectly suit your measurement requirements.

By selecting a predefined SOP, for example, dispersion process and duration, measuring frequency and time intervals are set automatically. For flexible adjustment you can also freely select it and many other parameters, save it as a separate SOP and retrieve it at any time. Your advantage: a completely new level of freedom in designing and structuring the entire dispersion and measurement process. And simple, reliable reproducibility of the measurement sequence.

FRITSCH Advantage
Security by individual user rights
The individual assignment of user rights allows you to define precisely for the user the access to data or the ability to influence measurement processes.

TECHNICAL DATA

MEASURING UNITS

	ANALYSETTE 22 NeXT Micro	**ANALYSETTE 22 NeXT Nano**
Measuring range	0.5–1500 µm	0.01–3800 µm
Method of analysis	Static light scattering (laser diffraction)	
Type of analysis	Wet measurement of the particle size of solids, suspensions and emulsions	
Measurement value	Particle size	
Theory	Fraunhofer, Mie	
Standard	ISO 13320	
Optical design	Reverse Fourier design	
Laser	Green (λ = 532 nm, approx. 1 mW)	
Laser beam alignment	Automatic	
Laser class according to IEC 60825-1	Class 1	
Detector	Specially designed semi-conductor detector	
Large angle detectors	No	Yes
Backward scattering channels	No	Yes
Typical measuring time	5–10 s (measurement value recording of an individual measurement) 1 min (entire measurement cycle)	
Evaluation	Particle size distribution as a total curve, bar chart or in table form	
Net weight	24 kg	25 kg
Dimensions (w x d x h)	66.6 x 31.9 x 29.4 cm	
Software	MaS control software for controlling, recording and evaluating the measuring results pre-installed on supplied computer, incl. monitor, keyboard and mouse (without computer hardware for deliveries to CIS countries)	
System requirements (for computers supplied by customer)	Standard Windows PC, 4 GB RAM, at least Windows 10, USB port, monitor, keyboard, mouse	

WET DISPERSION UNIT

Type of wet dispersion	Closed liquid circulation system
Suspension volume	150–500 ml, variable
Radial pump	With adjustable speed 3.5 l/min
Materials used in the sample circulation system	High-quality stainless steel 316L, PTFE, BK7 glass, Viton®, hoses made of LEZ SIL®
Conversion kit Extended for extreme chemical resistance (optional)	Seals and a flow plate made of FFKM Kalrez®, hoses made of LEZ SAN®
Sample material characteristics	Suspensions, emulsions and solids that do not agglomerate, are not soluble in the dispersion liquids or are poorly free-flowing or are sticky
Sample quantity	Some 10 mg (µm range) to a few grams (mm range) depending on the sample material and particle size
Net weight	13 kg
Dimensions (w x d x h)	29 x 27.2 x 29 cm

ULTRASONIC BOX

Output	Adjustable up to 50 Watt
Materials used in the sample circulation system	High-quality stainless steel 316L, Viton®, hoses made of LEZ SIL®
Sample material characteristics	Suspensions, emulsions and solids that agglomerate
Net weight	4.8 kg
Dimensions (w x d x h)	29 x 9 x 27.9 cm

ORDERING DATA

Order no. **Article**

LASER PARTICLE SIZERS

ANALYSETTE 22 NeXT MICRO / ANALYSETTE 22 NeXT NANO

MEASURING UNITS

22.9000.00 ***Measuring unit ANALYSETTE 22 NeXT Micro***
with USB interface and software MaS control already pre-installed on supplied computer, incl. monitor, keyboard, mouse*
for 100-240 V/1~, 50-60 Hz, 50 Watt

22.9040.00 ***Measuring unit ANALYSETTE 22 NeXT Nano***
with USB interface and software MaS control already pre-installed on supplied computer, incl. monitor, keyboard, mouse*
for 100-240 V/1~, 50-60 Hz, 50 Watt

ACCESSORIES

22.9200.00 ***Wet dispersion unit***
automatic dispersion unit, volume 150-500 ml

22.9287.00 ***Conversion kit Extended for extreme chemical resistance***
for wet dispersion unit
consisting of seals, flow plate and hoses

22.9270.00 ***Ultrasonic box***
for dispersion with ultrasonic with max. 50 Watt ultrasonic output, variably adjustable
for 200-240 V/1~, 50-60 Hz, 60 Watt

22.9280.00 ***Ultrasonic box***
for dispersion with ultrasonic with max. 50 Watt ultrasonic output, variably adjustable
for 100-120 V/1~, 50-60 Hz, 60 Watt

*without computer hardware for deliveries to CIS countries

Order no. **Article**

REFERENCE MATERIALS AND CERTIFICATES

ANALYSETTE 22 NeXT MICRO / ANALYSETTE 22 NeXT NANO

Certified reference materials (NIST-traceable) for performance verification according to ISO 13320

85.2220.00 Test powder for wet dispersion, 10 - 100 µm
(box with 10 single-shots 0.5 g)

85.2240.00 Test suspension nano (approx. 200 nm) for system check
(box with 10 single-shots 5 ml)

85.2250.00 Test suspension 1 µm for system check
(box with 10 single-shots 5 ml)

85.2260.00 Test suspension 10 µm for system check
(box with 10 single-shots 5 ml)

FRITSCH reference materials according to ISO 13320

85.2100.00 FRITSCH test powder F-500, 0.5 - 50 µm for wet dispersion
(50 g)

Certification

96.0070.00 Set of IQ/OQ blank forms
(questionnaire format – implementation by customer – standards not included)

Certificates for testing according to ISO 13320 on request.

SPARE PARTS WET DISPERSION UNIT

22.9251.26 Measuring cell glass 4 mm for flow measuring cell
22.9261.15 Seal set standard for flow measuring cell
22.9262.16 Seal set Extended for extreme chemical resistance for flow measuring cell

Sample division
For representative sample division, we recommend the Rotary Cone Sample Divider LABORETTE 27 – the foundation of any precise analysis.
More information is available at www.fritsch-international.com/l-27.

Maintenance and recalibration of your Particle Sizer upon request.

Colour ink jet printer and laser printer on request.

Benefit from our experience!

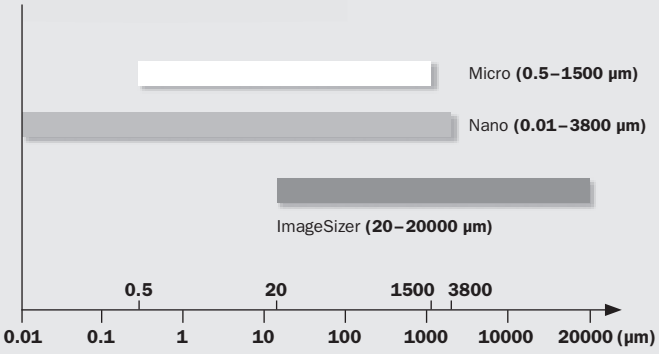
Choose FRITSCH Particle Sizers to take advantage of the technical superiority resulting from more than 35 years of practical experience in the field of high-tech particle technology.

Today, the Static Light Scattering in a convergent laser beam introduced by FRITSCH with the ANALYSETTE 22 is an international standard.

With the ANALYSETTE 28 we set a new standard for particle shape and size analysis with Dynamic Image Analysis for fast and easy quality control in the industrial sector.

ANALYSETTE 22 NeXT
Micro – Nano
Static Light Scattering

ANALYSETTE 28
ImageSizer
Dynamic Image Analysis



Worldwide at your service
in 116 countries

Always nearby
Wherever you use your FRITSCH instruments: we are nearby. With technical service and direct contact persons for application consultation who will help you for example, to determine your SOPs.

Practical remote maintenance
Using the remote maintenance module via Internet, our service technicians will help you through any problem – quickly, direct and uncomplicated. We are happy to inform you about our customised maintenance contracts.

Showing you how it's done
Our applications laboratory will be more than glad to help you find the perfect Particle Sizer for your specific task. If desired, within the scope of a product recommendation, we will conduct a particle analyses of your material. Simply request at www.fritsch-international.com/service/sample-analysis.

The result will convince you.

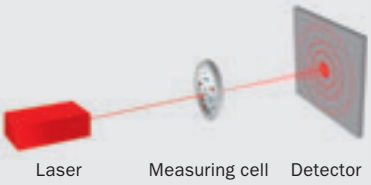
Our expert Maik Paluga will be happy to assist you in all questions regarding FRITSCH particle sizing and its application possibilities.

+49 67 84 70 188 · paluga@fritsch.de
www.fritsch-international.com/particle-sizing

BRIEF INTRODUCTION INTO LASER PARTICLE SIZE MEASUREMENT

LASER SCATTERING PRINCIPLE

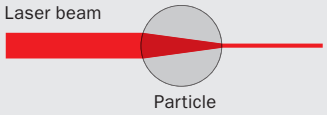
Particle sizing with laser scattering is actually quite easy: To measure the size of a particle it is irradiated by a laser beam. The partial deflection of the laser light creates a characteristic ring-shaped intensity distribution behind the sample that is measured by a specially shaped detector. The distance of these rings is used to calculate the particle size: Large particles produce closely adjacent rings; smaller particles produce rings further apart. That is the principle.



BASIC TERMS

When illuminating a particle with light, various effects occur that together cause a weakening of the light beam. This extinction is basically the sum of absorption and the deflection of the light from the original direction.

During absorption, the particle absorbs part of the electromagnetic energy of the incident light and converts it mostly into heat. This phenomenon plays an important in the Mie theory.

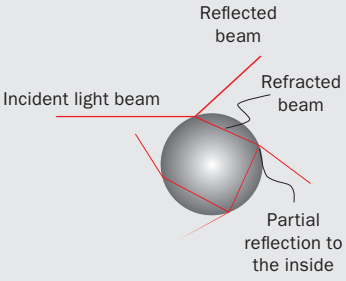


Three different effects basically contribute to the deflecting of the incident light: diffraction, reflection and refraction.

- To understand **diffraction**, you have to imagine the light beam as a broad wave front. When this wave front strikes a particle, new waves are produced at its edges that run into different directions. The overlapping of the numerous new waves (interference) creates a characteristic diffraction pattern behind the particle that is clearly determined by the diameter of the particle. Its exact progression is described by the Fraunhofer theory.

- The **reflection** occurs mostly on the surface of a particle – according to the law: incidence angle equals reflection angle. This part of the scattered light cannot be used for the particle size determination.

- With **refraction**, the direction of a light beam changes during the transfer from one material to the next with different refraction indexes. A light beam that strikes a rain drop for example, is refracted first of all in the direction of the middle of the drop and is always reflected back into the drop when exiting the outer edge of the drop. Part of the light thereby always escapes the drop during every reflection.

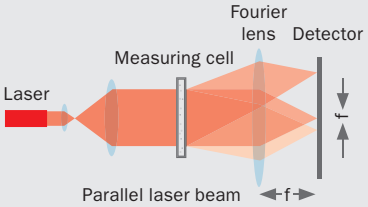


DESIGN OF A LASER PARTICLE SIZER

An important component of every Laser Particle Sizer is the Fourier lens which focusses the scattered light of the laser within the beam path onto the detector. Its position defines the key difference between the conventional design and the Reverse Fourier design.

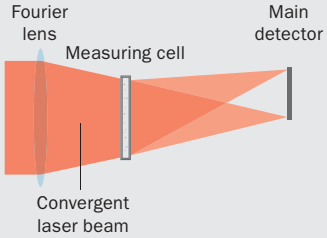
- **Conventional design**

  In a conventional design, the Fourier lens is situated between the detector and the measuring cell which is penetrated by a wide, parallel laser beam. Its disadvantage: Only a limited particle size range can be detected and if the measuring range needs to be changed, the lens needs to be exchanged and precisely adjusted. And the possibility to measure large scattering angles for especially small particles is greatly limited.



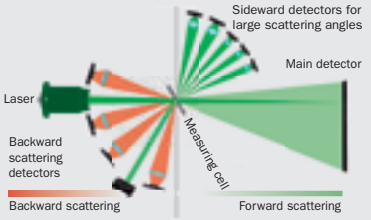
- **FRITSCH technology: Reverse Fourier design**

  35 years ago, FRITSCH was the first company in the industry to bring a revolutionary alternative to the conventional design onto the market in the form of laser diffraction in a convergent laser beam: By positioning the Fourier lens in front of the measuring cell, a convergent laser beam passes through the measuring cell. The scattered light is focused directly on the detector without additional optical elements. This design is now in widespread use and can be designed so that a main detector can be used to capture small scattering angles for measuring larger particles. For the large scattering angles of the small particles, a suitable detector system then needs to be integrated for the sideward and backward scattering.



- **FRITSCH technology: Simple measurement of backward scattering**

  For detecting particles with a diameter of less than 100 nm, it is necessary to measure the backward scattered light (scattering angle greater than 90°). For this purpose, the detectors were specially positioned close to the measuring cell in the ANALYSETTE 22 NeXT Nano. A laser with green light that is also used simultaneously for measuring forward and sideward scattering is used as a light source. Particular attention was placed in the design of the backward detectors on the suppression of undesirable signal components, caused, for example, by reflection on the measuring cell glasses.



DISPERSION

An optimally dispersed sample is the basic prerequisites for a reliable determination of the particle size distribution. In most cases, agglomerates need to be degraded and the correct particle concentration of the sample material needs to be set. Basically, the dispersion process can be done in an air flow (dry dispersion) as well as in a liquid (wet dispersion). Numerous materials have to be measured by wet dispersion. This includes sticky materials such as clay or materials that tend to agglomerate when dry. Even with very fine powders with particle sizes smaller than about 10 µm, the agglomerates can often be degraded only incompletely using dry dispersion.

PH VALUE AND TEMPERATURE

To get an optimally dispersed sample, two parameters are of great importance for measurements in an aqueous suspension: the temperature and the pH value. The **pH value** is an important parameter for the stability of a suspension. If it shifts during the measurement, flocculation (coagulation) of particles may occur, which is a frequent cause for non-reproducible measuring results.

A **low temperature** makes the degradation of agglomerates difficult and simultaneously increases the risk of air bubbles forming in the measuring circuit. Warmer water, on the other hand, significantly supports the dispersion. In addition, the gas content is reduced significantly and therefore also the risk of bubble formation.

Using the ANALYSETTE 22 NeXT you can measure the temperature as well as the pH value continuously during the measurement.

$$pH = -\log_{10}(a(H^+))$$

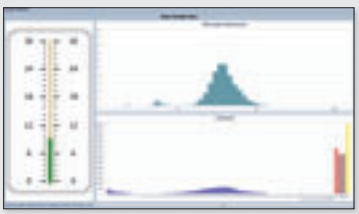
$$\overline{E_{kin}} = \frac{3}{2} k\bar{T}$$

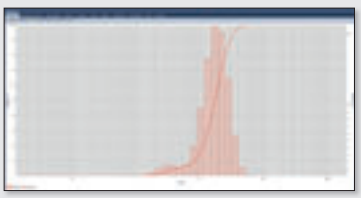
TYPICAL MEASURING PROCESS

The basic process of a size distribution measurement is always the same: First of all, a so-called background measurement is carried out during which the signals of all detector elements are recorded without sample material being fed in. This makes it possible to record soiling of the measuring cell, for example, to be calculated out later.

Afterwards the software prompts the user to feed sample material into the dispersion unit. During this process the system continuously provides feedback by means of the so-called beam absorption whether the required sample quantity has been reached yet or still more material needs to be added. Once the proper quantity has been reached, the actual measurement data acquisition takes place automatically with subsequent calculation of the particle size distribution. Afterwards, following a freely programmable time, the process of the measurement data acquisition with subsequent results calculation can be repeated multiple times in a loop. Thus, the reproducibility of the measurement can be easily checked.

Afterwards the sample system is emptied automatically and the system is filled with fresh liquid.



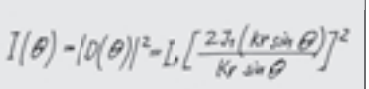


THEORIES FOR ANALYSIS

The actual result of a particle size measurement is provided only after the evaluation with the supplied FRITSCH software MaS control. Depending on the particle characteristics and requirements, two common analysis theories are applied: the Fraunhofer theory for larger particles whose optical parameters are not known and the Mie theory for smallest particles with known optical parameters. In the FRITSCH MaS control software you can simply choose both theories.

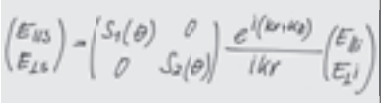
The Fraunhofer theory

The Fraunhofer theory describes the part of the light deflection that is only caused by diffraction. If light falls on an obstacle or an opening, then diffraction and interference effects occur. If the incident light falls parallel (even wave fronts), then you speak of Fraunhofer diffraction. This is always the case if the light source is at infinity or is “shifted” there by a lens. Since the light deflection by diffraction is dominant for sufficiently large particles, the Fraunhofer theory can be applied for particle size measurement down into the lower micrometre range. A great advantage of the Fraunhofer theory is that no knowledge is necessary of the optical characteristics of the analysed material.



The Mie theory

The Mie theory is used for evaluating the measurements of particles whose diameters are not significantly larger than the wavelength of the light used. This theory, developed by Gustav Mie at the beginning of the 20th century, is the complete solution of the Maxwell equations for the scattering of electromagnetic waves on spherical particles. It can be used to analyse the characteristic intensity distributions for even very small particles which, contrary to the Fraunhofer theory, are not limited to scattering angles less than 90° (forward/sideward direction), but which also occur for scattering angles greater than 90° (backward direction). In order to make use of the determined intensity distribution for calculating the particle size, the refraction index and the absorption index of the sample material need to be known for the Mie theory as opposed to the Fraunhofer theory. The FRITSCH software MaS control provides a comprehensive database for that which contains the refraction index of numerous materials.



Our expert Maik Paluga will be happy to assist you in all questions regarding FRITSCH particle sizing.

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