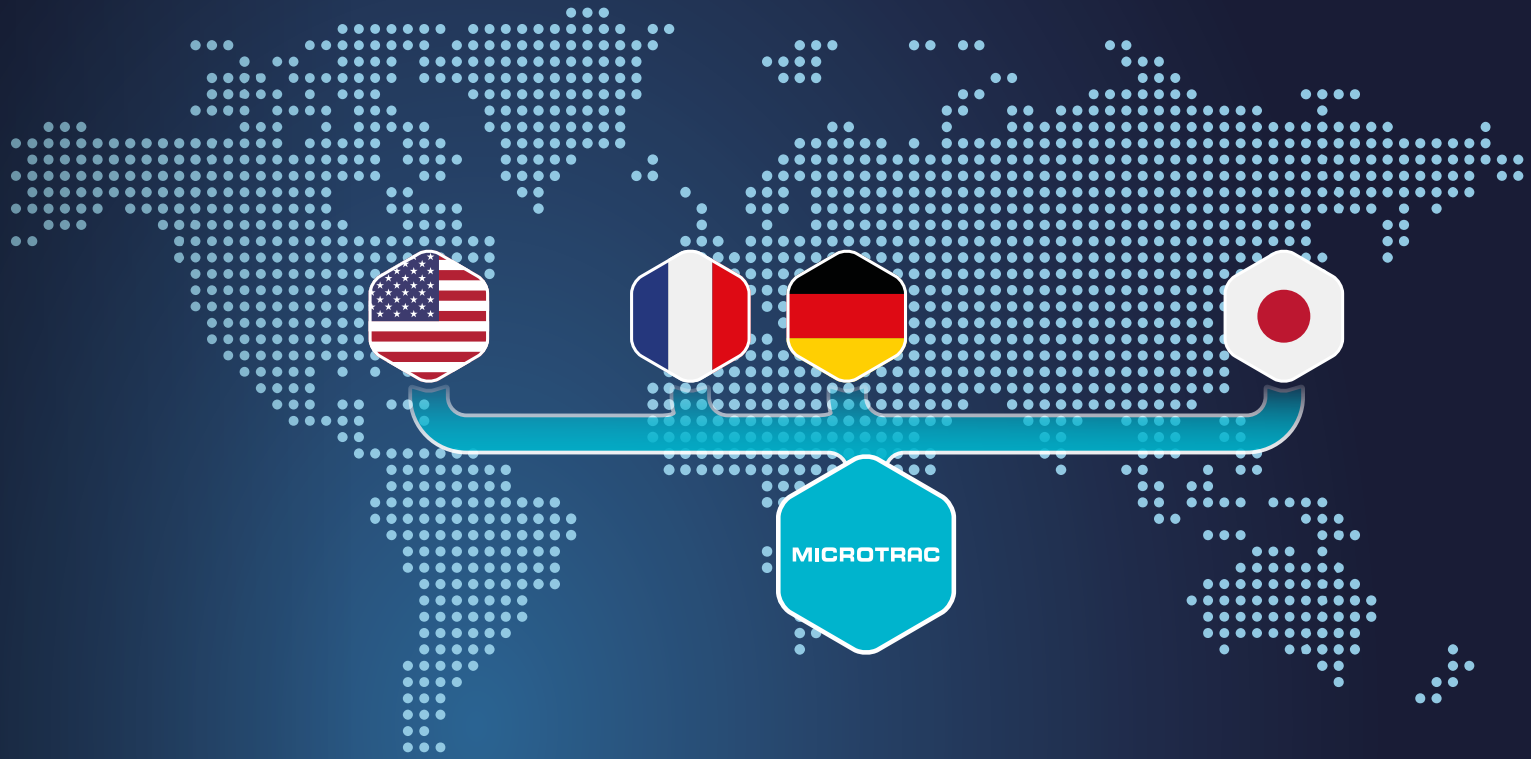
MICROTRAC
PARTICLE CHARACTERIZATION

TURBISCAN
RANGE

SHELF-LIFE & DISPERSIBILITY ANALYZERS

THE WORLD REFERENCE STABILITY ANALYZER BY STATIC MULTIPLE LIGHT SCATTERING

part of VERDER scientific



MICROTRAC

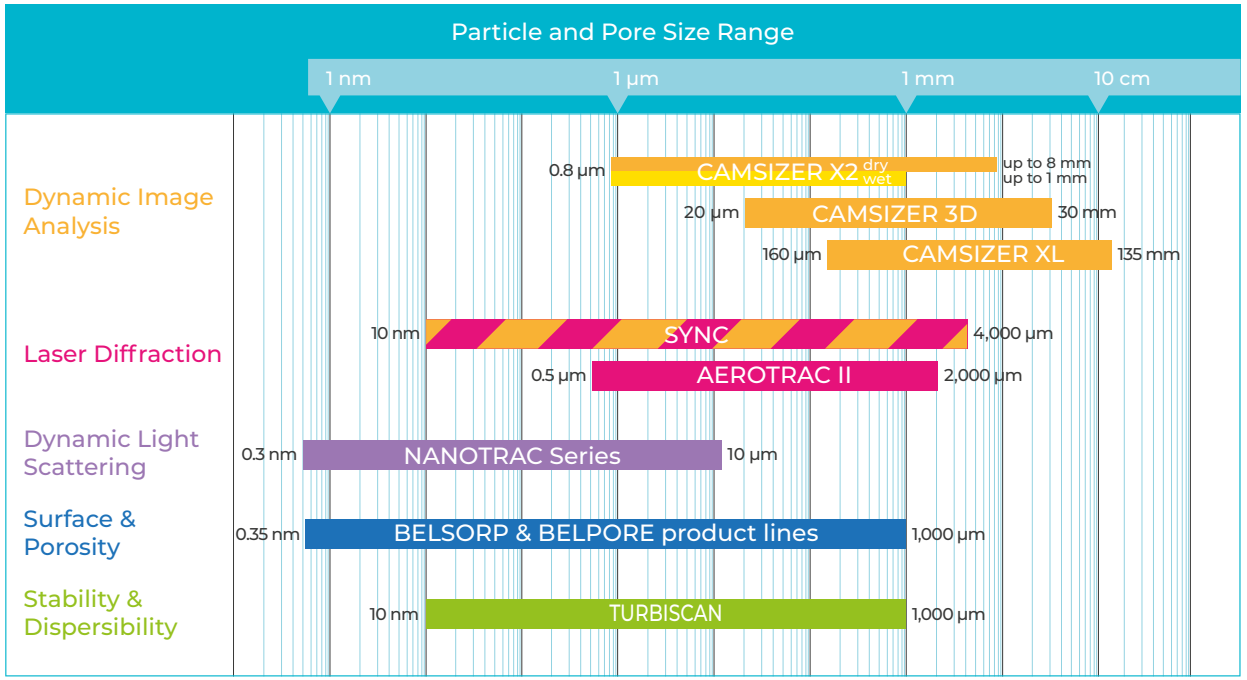
PARTICLE CHARACTERIZATION AT ITS BEST

Microtrac is your preferred partner for the comprehensive characterization of particulate systems. We provide our customers with advanced technologies to obtain consistently reliable results. Innovation and quality are at the core of everything we do.

As part of Verder Scientific, we provide worldwide support through a network of subsidiaries and distributors.

MICROTRAC

THREE PILLARS OF EXCELLENCE



GAS ADSORPTION MEASUREMENT

The BELSORP and BELPORE analyzers are used for the determination of gas and vapor adsorption amounts, as well as BET surface area and pore size distribution. The measuring instruments use gas adsorption technology to analyze both porous and non-porous powder materials.

These products are used all over the world in Research and Development, Quality Control, and Quality Assurance. The competence centers for these product lines are located in Osaka (Japan) and Haan (Germany).

PARTICLE SIZE & SHAPE ANALYSIS

Dynamic Image Analysis (DIA) and Laser Diffraction (LD) technologies are used in our optical particle analyzers for the physical characterization of particles. Microtrac is the only worldwide supplier of dynamic image analysis, static image analysis, laser diffraction, and sieve analysis equipment.

DIA is used to determine size distributions and shape parameters quickly with excellent accuracy and reproducibility over a wide measuring range. Microtrac's renowned CAMSIZER system was introduced over 20 years ago and has pushed technological innovation ever since. These instruments are developed and built in our production site in Haan, Germany.

In 2024, Microtrac celebrates 50 years of Laser Diffraction as a global leader. We are pioneers in this field, with our SYNC range. By continuously improving the instrument technology, we offer customers a robust portfolio of laser diffraction instruments that are ideal for particle sizing and characterization. The development and production site for this product line is located in Pennsylvania, USA.

STABILITY & DISPERSIBILITY ANALYSIS

Our Stability Analyzers use Dynamic Light Scattering (DLS) to measure particle size, and Static Multiple Light Scattering (SMLS) and Zeta Potential (ZP) to measure the stability and dispersibility of all your formulas. The latest addition to the Microtrac portfolio is the TURBISCAN range.

With TURBISCAN, Microtrac offers the world leading technology for Shelf-Life and Dispersibility analysis of liquid dispersions and formulations. The TURBISCAN range is developed and built in our factory in Toulouse, France.

TURBISCAN RANGE

THE WORLD LEADER IN SHELF-LIFE AND STABILITY ANALYSIS

SAVE TIME

Up to 1,000 times faster compared to a conventional visual stability test

DETECT & QUANTIFY

Sedimentation, phase separation, aggregation, coalescence, coagulation, creaming...

All destabilizations are detected and quantified

OBJECTIVE & RELIABLE

Instrumental method, no dilution, no external stress, measure the sample as is – analysis you can trust

WIDE RANGE OF APPLICATIONS

Suspensions, emulsions, foams, from low to high concentrations (10^{-4} - 95% v/v), opaque, clear, coloured samples, from nano to macro (10 nm to 1 mm).

STATIC MULTIPLE LIGHT SCATTERING (SMLS)

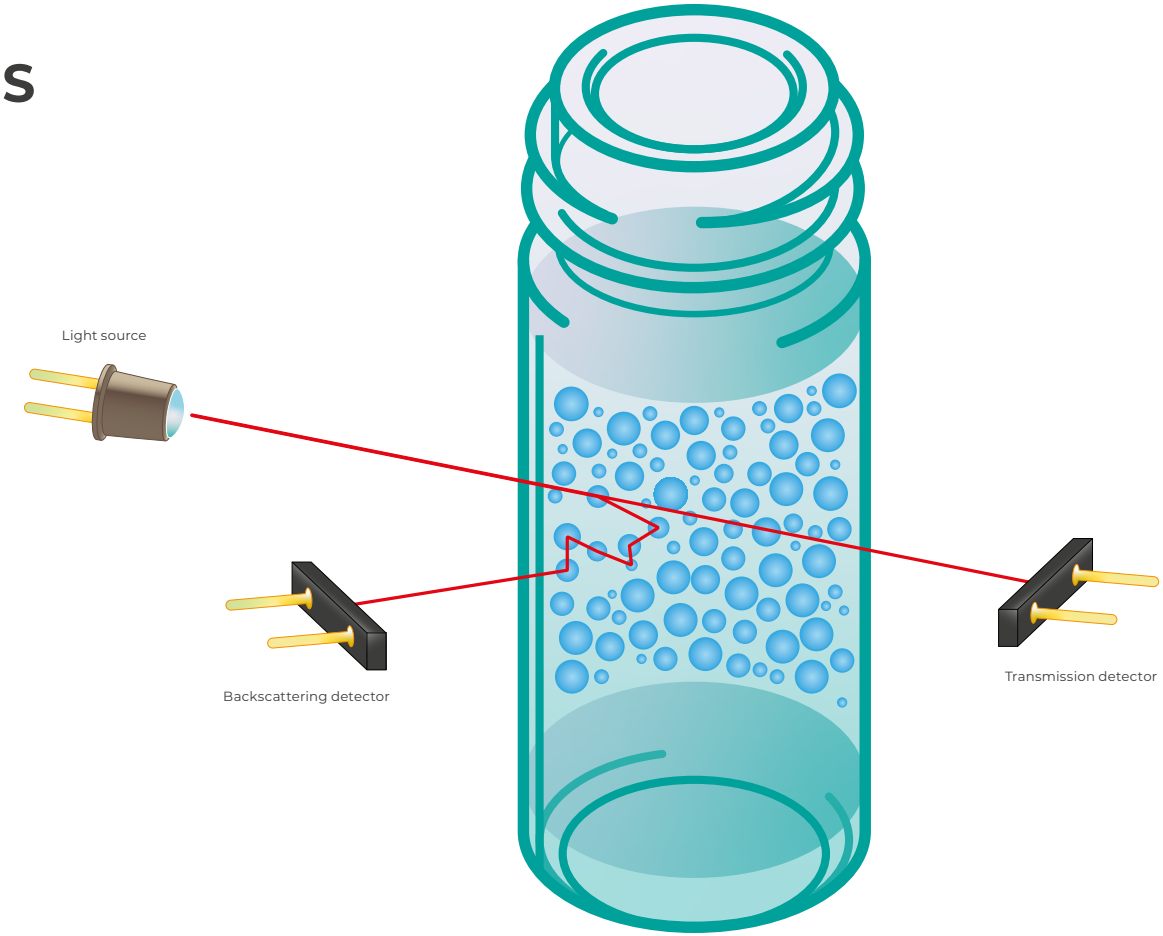
CUTTING-EDGE STABILITY AND DISPERSIBILITY TECHNOLOGY COUPLED WITH SMART DATA ANALYSIS

Turbiscan is based on the **Static Multiple Light Scattering (SMLS)** technology, the most suitable method to characterize liquid dispersions, directly, in their native state.

In most emulsions, suspensions and formulations the concentrations are too high to be analyzed “as is” with light scattering and their characterization requires dilution or mechanical stress, altering their state and structure. SMLS offers the ability to investigate the **dispersion state** and its **evolution over time, without any dilution,** even on highly concentrated samples.

SMLS offers extraordinary resolution to detect **size and concentration** variation occurring in complex formulations and in a very wide range of applications and industries. As a direct optical method that does not require sample preparation (such as dilution), SMLS is in perfect agreement with ISO norms regarding shelf-life and stability measurements (ISO/TR 13097:2013, ISO/TR 18811:2018).

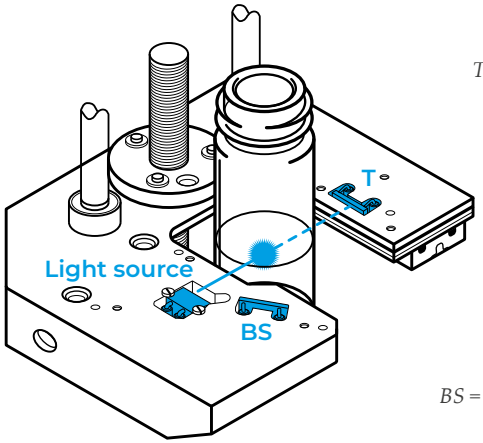
Standards: ISO/TS 21357:2022 for particle size, and ISO 13317 for particle size distribution



TURBISCAN RANGE

HOW DOES IT WORK

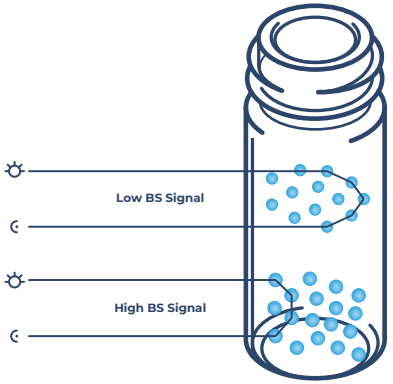
SCANNING READING HEAD



$$T = T_0 \exp\left(\frac{-3r_i \phi Q_e(d)}{d}\right)$$

d	mean particle size
ϕ	particle concentration
ri	cell radius
Qe	extinction efficiency
α, β	gain and offset

$$BS = \alpha\sqrt{\frac{3\phi(1-g(d)Q_e(d)}{2d}} + \beta$$



STATIC MULTIPLE LIGHT SCATTERING (SMLS)

SMLS consists of sending photons (NIR light source, 880nm) into the sample.

These photons, after being scattered many times by the particles (or droplets) in the dispersion, emerge from the sample and are detected by two synchronous detectors:

- **Backscattering** is measured at 135° for **opaque samples**
- **Transmission** at 0° from the light source for **transparent samples.**

HIGH RESOLUTION TO THE SMALLEST VARIATION OF PARTICLE SIZE VARIATION AND MIGRATION

Backscattering (BS) and Transmission (T) intensities are directly related to particle size (d) and particle concentration (ϕ) and are extremely sensitive to the smallest variation.

SCANNING MODE

Backscattering (BS) and Transmission (T) are acquired every 20 microns along the sample height. Scans are repeated to detect any variation of the concentration (migration) or particle size variation (aggregation, flocculation) in function of time.

ADVANTAGES

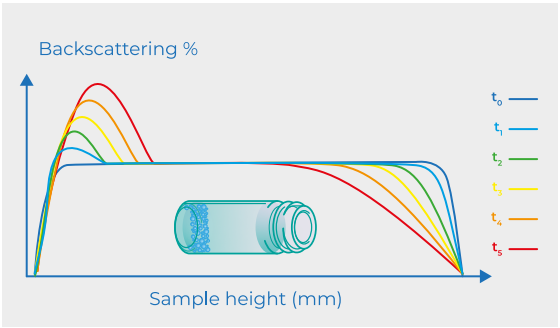
- Sensitive to the slightest variation of particle size and concentration
- Non-dilution, native samples
- High space resolution: 20µm scanning
- Single technique, huge possibilities:
  From: 10 nm to 1 mm
  From: 10^{-4} up to 95% v/v
- Works on any dispersion : suspensions, emulsions and foams
- Fast stability measurement

STATIC MULTIPLE LIGHT SCATTERING (SMLS)

DATA AT A GLANCE

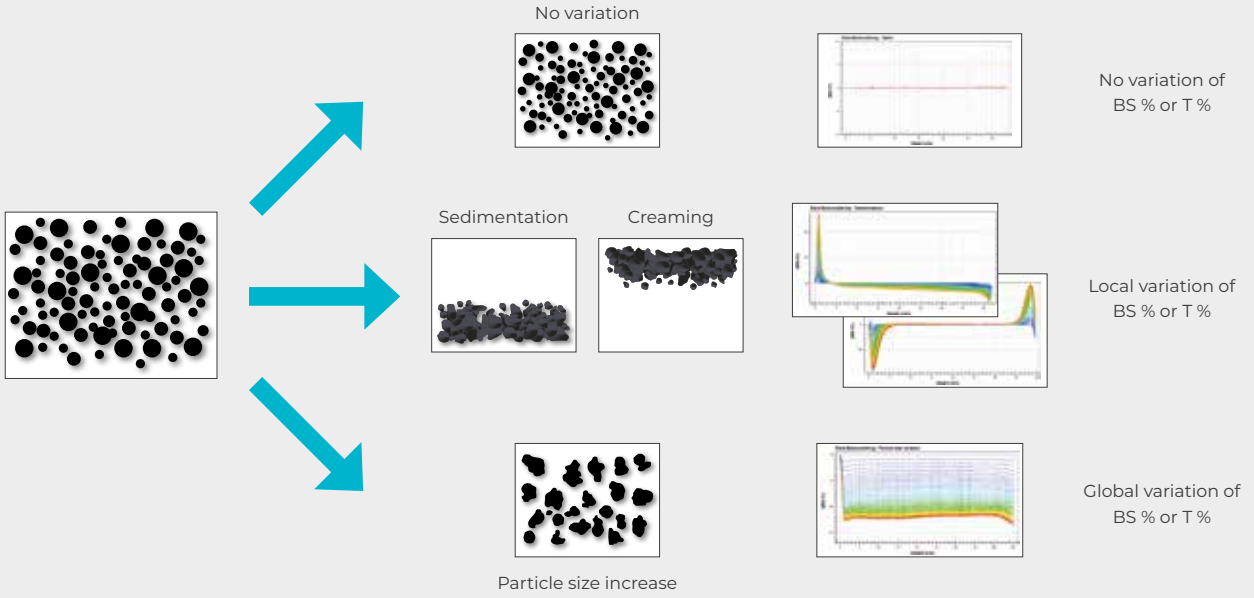
DATA REPRESENTATION

Scans are overlayed on the same graph and in function of sample height. Each scan has a specific colour from blue - first scan to red - last scan to easily understand signal variations in function of time.



DESTABILIZATION DETECTION

In the case of destabilization, deviations in scans are detected as a function of sample height. Due to the high sensitivity of the SMLS technology, destabilizations are detected in their very early stage and **up to 1,000 times faster** than visual observation.



TURBISCAN SMART ANALYSIS

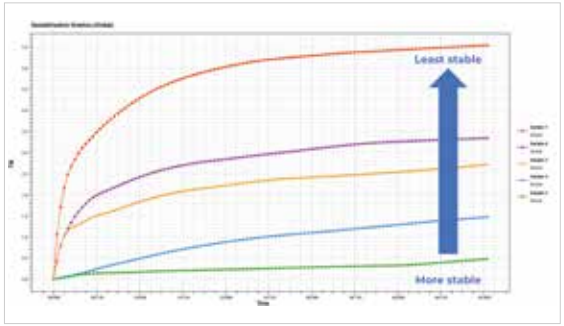
ON-BOARD TECHNOLOGY FOR ONE-CLICK RESPONSE

TURBISCAN STABILITY INDEX – TSI

Turbiscan Stability Index (TSI) sums all the signal variations along the entire sample height and therefore, takes into account all destabilizations occurring. Thanks to the TSI, sample comparison is easy as the higher the TSI, the lower the stability.

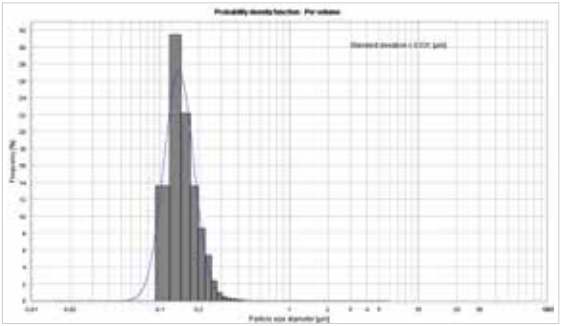
The key points of the TSI: it is “one-click” and fully automatic, operator-independent, and does not require any data input.

The TSI is used in R&D labs for formula stability comparison and optimization, Quality Control as well as for academic research and quickly becoming the stability criteria.



PARTICLE SIZE & DISTRIBUTION

Particle size distribution is determined from migration profiles and migration velocities and offers to investigate size and its distribution in native samples and without any pumping, dilution or mechanical stress. Standard: ISO 13317.



SHELF-LIFE & DISPERSIBILITY
ANALYZER TURBISCAN

THE BEST TECHNOLOGY FOR FAST & NON-INVASIVE STABILITY ANALYSIS

NUMBER OF SAMPLES 1

TEMPERATURE RANGE RT–60 °C

TURBISCAN STABILITY INDEX TSI

TURBISCAN LAB

THE WORLD REFERENCE STABILITY ANALYZER

Turbiscan LAB allows fast and sensitive identification of destabilization mechanisms (creaming, sedimentation, flocculation, coalescence, ...). A temperature-controlled measurement chamber allows stability monitoring at specific storage temperatures or acceleration of the destabilization process with a temperature increase up to 60 °C.

Turbiscan LAB can be used in both R&D and QC labs for the development and routine control of raw materials and final product formulations. The Turbiscan technology does not only detects stability evolution at an early stage (up to 1,000 times faster compared to visual testing) but also quantifies global formula evolution with the Turbiscan Stability Index (TSI) scale.

FEATURES

- Static Multiple Light Scattering (SMLS) Technology
- 1 sample position
- Temperature range: from **RT to 60 °C**
- Accelerated destabilization detection **up to 1,000x faster** than visual observation
- **Real stability:** No dilution (10^{-4} up to 95% v/v) – No mechanical stress
- Destabilization quantification: migration velocity, particle size
- One click stability ranking with the **Turbiscan Stability Index** (TSI)
- Bar code reader for easy sample management
- Convenient: plug & play, free licence software, multiple computers, limited footprint
- Standards: ISO/TR 13097:2013, ISO/TS 22107:2021, ISO/TS 21357:2022, ISO 13317

TURBISCAN TRILAB

3-SAMPLE MACROSCOPIC & COLLOIDAL STABILITY ANALYZER

Turbiscan TRILAB is a multi-sample stability analyzer based on the SMLS technology. It enables fast and reliable shelf-life studies of formulations (emulsions, suspensions, foams).

The TRILAB offers several advantages for studying the stability of dispersed systems. It allows simultaneous and independent analysis of **up to 3 samples,** thus saving time and resources. It provides a comprehensive and quantitative characterization of the physical phenomena involved in destabilization, such as sedimentation, creaming, flocculation, or coalescence. Not only does it save time thanks to the extreme sensitivity of the SMLS technology, it also enables accelerated stability tests by varying the temperature from **20 °C to 60 °C** and follows ISO recommendations (ISO TR/13097:2013, ISO/TR 18811:2018). The stability measurement is done with a non-invasive and non-destructive measurement, preserving the integrity and nature of the samples.

The Turbiscan technology guarantees a direct reading of macroscopic and colloidal stability without dilution or mechanical stress.

NUMBER OF SAMPLES 3

TEMPERATURE RANGE 20–60 °C

TURBISCAN STABILITY INDEX TSI

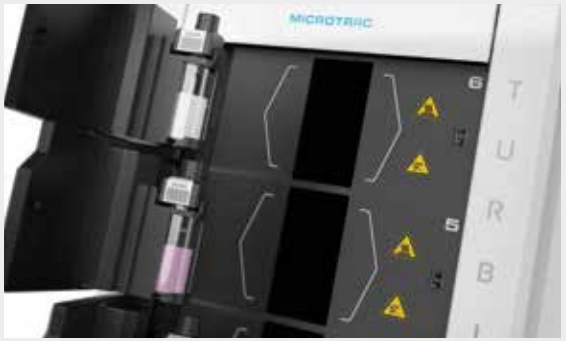
FEATURES

- Static Multiple Light Scattering (SMLS) Technology
- **3 independent sample positions**
- Temperature range: from **20 °C to 60 °C**
- Accelerated destabilization detection **up to 1,000x faster** than visual observation
- **Real stability:** no dilution (10^{-4} up to 95% v/v) – No mechanical stress
- Destabilization Quantification: migration velocity, particle size
- One click stability ranking with the **Turbiscan Stability Index** (TSI)
- Sample management via bar code & LCD screen with measurement status and stability results
- Convenient: plug & play,free licence software, multiple computers, limited footprint
- Standards: ISO/TR 13097:2013, ISO/TR 18811:2018, ISO/TS 22107:2021, ISO/TS 21357:2022, ISO 13317

The measurement cell is placed directly in the trap door's sample holder.

TURBISCAN TOWER

6-SAMPLE MACROSCOPIC & COLLOIDAL STABILITY ANALYZER



Turbiscan TOWER is the flagship product of the Turbiscan range, for fast, precise, and quantitative stability measurement of formulations (emulsions, suspensions, foams).

The TOWER offers **6 independent measurement positions** allowing simultaneous formulation comparison or providing flexibility when working on different projects. It allows fast and accurate assessment of the stability and aging of any formulation (highly concentrated and opaque to water-like systems). Any changes occurring in the dispersion, such as sedimentation, flocculation, creaming, and coalescence will be detected and quantified right away. Not only does it save time thanks to the extreme sensitivity of the SMLS technology, but it also enables accelerated stability tests by varying the temperature from **4 °C to 80 °C** and follows ISO recommendations (ISO/TR 13097:2013, ISO/TR 18811:2018). The stability measurement is done with a non-invasive and non-destructive technique, preserving the integrity and nature of the samples. The results are saved into the software and are also displayed on the front screen with an easy reading of the stability thanks to a simple color code.

The Turbiscan Tower helps to design, improve, and monitor the quality of formulations and dispersions cost-effectively and reliably. Make fast decisions based on facts.

6
NUMBER OF SAMPLES

4–80 °C
TEMPERATURE RANGE

TSI
TURBISCAN STABILITY INDEX

FEATURES

- Static Multiple Light Scattering (SMLS) Technology
- **6 independent sample positions**
- Temperature range: from **4 °C to 80 °C**
- Accelerated destabilization detection up to 1,000x faster than visual observation
- **Real stability:** no dilution (10^{-4} up to 95% v/v) – No mechanical stress
- Destabilization Quantification migration velocity, particle size
- One click stability ranking with the **Turbiscan Stability Index** (TSI)
- Sample management via bar code & LCD screen with measurement status and stability results
- Convenient: plug & play, free licence software, multiple computers, limited footprint
- Standards: ISO/TR 13097:2013, ISO/TR 18811:2018, ISO/TS 22107:2021, ISO/TS 21357:2022, ISO 13317

NUMBER OF SAMPLES 54

TEMPERATURE RANGE RT–60 °C

TURBISCAN STABILITY INDEX TSI

TURBISCAN AGS

HIGH-THROUGHPUT STABILITY ANALYZER

The Turbiscan AGS is a high-throughput stability analyzer to shorten a formulations' time-to-market and for quality control.

Stability is one of the key parameters for the development and quality control of dispersed systems, such as emulsions, suspensions, or foams.

Assessing the stability of such systems requires reliable and sensitive methods that can detect and quantify the physical phenomena involved, such as creaming, sedimentation, flocculation, or coalescence.

Turbiscan AGS combines:

- SMLS technology for fast, quantitative, and reliable stability and shelf-life measurement
- Automated sample handling system working **24/7**
- Storage unit for **54 samples** split in **3 temperature-controlled** racks (up to 60 °C)
- Smart software for automatic sample handling and reporting

Turbiscan AGS is the ideal companion when dealing with large batches of samples, it operates 24/7 and without any human intervention, stability measurements and giving you the time to focus on what matters.

FEATURES

- Static Multiple Light Scattering (SMLS) Technology
- 3 independent thermoregulated racks of 18 samples for a total of **54 samples**
- Temperature range: from **RT to 60 °C**
- Accelerated destabilization detection **up to 1,000x faster** than visual observation
- **Real stability:** no dilution (10^{-4} up to 95% v/v) – No mechanical stress
- **Fully automated** robotic station working 24/7
- Destabilization quantification, migration velocity, particle size diameter...
- One click stability ranking with the **Turbiscan Stability Index** (TSI)
- **Convenient:** free licence software, multiple computers, limited footprint
- Standards: ISO/TR 13097:2013, ISO/TR 18811:2018, ISO/TS 22107:2021, ISO/TS 21357:2022, ISO 13317

NUMBER OF SAMPLES 1

TEMPERATURE RANGE RT-60 °C

TURBISCAN STABILITY INDEX TSI

TURBISCAN DNS

DISPERSIBILITY AND STABILITY ANALYZER

Turbiscan DNS is a cutting-edge technology that offers a comprehensive solution for measuring the dispersibility and stability of emulsions, suspensions, and foams.

With its advanced optical system and sensitive detectors (Static Multiple Light Scattering – SMLS), Turbiscan DNS can accurately detect and quantify changes in the physical properties of these complex systems over time. The measurement of the dispersibility and stability is done via two functions:

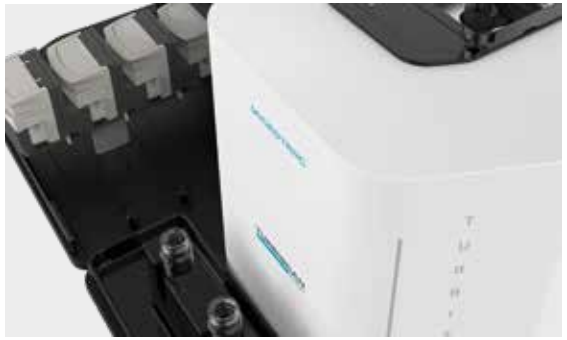
- **DISPERSIBILITY STUDIES**
  Measurement while processing the formulation or dispersion (online or mixing done directly in the measurement vials) allows precise dispersibility studies (ISO/TS 22107:2021).
- **SHELF-LIFE STUDIES**
  At rest and without any additional forces, for a fast and quantitative measurement.

All the measurements are done without dilution on the native sample to provide a clear and reliable measurement of the dispersion state and its evolution.

This powerful tool enables researchers and manufacturers to optimize their formulations, identify stability issues early on, and ensure consistent product quality. Whether you are developing new products or improving existing ones, Turbiscan DNS provides the insights you need to make fast decisions and stay ahead of the competition.

FEATURES

- Static Multiple Light Scattering (SMLS) Technology
- Temperature range: **from RT to 60°C**
- Accelerated destabilization detection **up to 1,000x faster** than visual observation
- **Real stability:** no dilution (10^{-4} up to 95% v/v) – No mechanical stress
- Destabilization quantification, migration velocity, particle size diameter...
- One click stability ranking with the **Turbiscan Stability Index** (TSI)
- Mixing and circulating function
- **Ultra-fast measurement** (up to 10 measurement per seconds).
- **Convenient:** plug & play, free licence software, multiple computers, limited footprint
- Standards: ISO/TR 13097:2013, ISO/TR 18811:2018, ISO/TS 22107:2021, ISO/TS 21357:2022, ISO 13317



TURBISOFT FOR TURBISCAN

DATA INTERPRETATION MADE SIMPLE

- Intuitive and straightforward navigation
- Fast and robust stability comparison thanks to the TSI algorithm
- Advanced calculation for deep data analysis: migration rate, mean particle size evolution, phase separation...
- Stay up to date: Free license – Free software updates
- Multi-user software
- Easy data export
- Sample destabilization movies
- Fully guided calibration check-up procedure
- Multi languages: English, Spanish, French, Chinese, Japanese, German ...

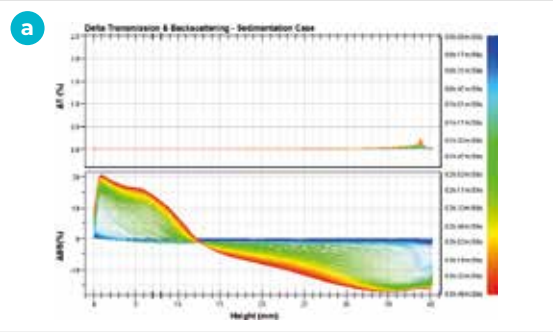
TURBISOFT FOR TURBISCAN

SELECTED FUNCTIONS

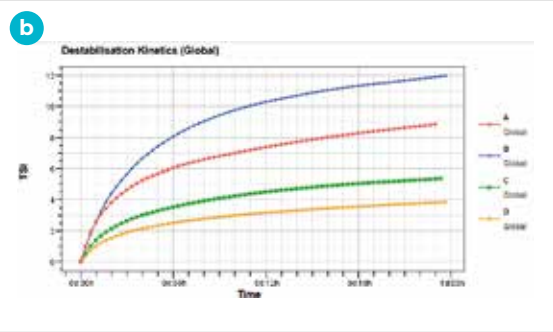
Data acquisition, interpretation, and export are done with the Turbisoft, the dedicated software for the Turbiscan range. Turbisoft is continuously optimized towards more intuitive and straight-forward data analysis, hence saving time, and helping users get the results they need in a few clicks.

- **Destabilization visualization** is made simple via automatic colour code (first scan in blue, last in red) and sample height detection **(graph a)**.
- **Turbiscan Stability Index** is computed fully automatically, without any input and in just a single click **(graph b)**.
- **Simulated destabilization video** can be reconstituted and compared (up to 6 samples) from the variation of the back-scattering and the transmission in function of time **(image c)**.
- **Histogram sample** ranking upon their TSI value at one time, and a color code is associated in regards of the destabilization importance **(graph d)**.
- **Advanced calculation** allows user to go deeper in the under-standing of the destabilization processes: phase separation kinetics, migration speed, particle size.... **(graph e)**.
- **Free license and multi-computer** – Turbisoft gives the flexibility you need to acquire, share, and analyze data on separate computers. If you are changing your operating system, the newest version of the software is free.

Data exportation can be done on every graph on the screen and as easy as “copy/paste”.



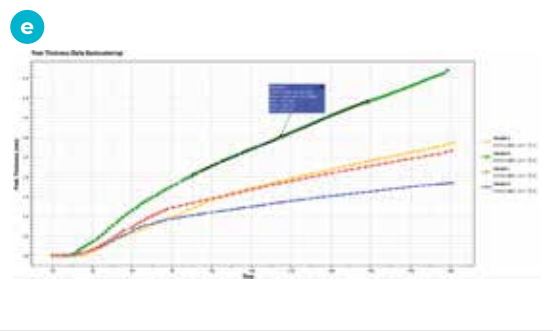
Transmission and backscattering in function of the sample height



Turbiscan stability index In function of time

Video representation of the destabilization

Sample ranking via TSI value



Advanced calculation and phase separation thickness kinetic

TURBISCAN RANGE

APPLICATIONS

When it comes to stability measurement, shelf-life studies and dispersibility,
the Turbiscan technology is the must-have instrument whatever the field you are working on.

TYPICAL FIELDS OF APPLICATION

- SPECIALITY CHEMICALS & POLYMERS
- PHARMACEUTICALS
- FOOD & BEVERAGES
- HOME & PERSONAL CARE
- COATINGS, PAINTS & INKS
- OIL & LUBRICANTS
- BATTERY & ELECTRONICS
- AGROCHEMICALS
- CONSTRUCTION MATERIALS

APPLICATIONS

EXPLORE OUR WIDE RANGE OF APPLICATIONS

Turbiscan technology (SMLS) can analyze a very wide variety of samples: opaque or clear, highly concentrated and very diluted, from nanoparticles to large floccs (mm), emulsions, suspensions, colloids, foams... The application field of the Turbiscan is limitless.

Turbiscan is used today in research & development, quality control as well as in the academic research field and is the reference technique for shelf-life studies and stability measurement.

KEY BENEFITS

- Time saving
- Detect & Quantify
- Objective and real stability

SPECIALITY CHEMICALS & POLYMERS

Surfactants, stabilizers, polymers and bio polymers, fillers and pigments, latexes, solvents....

PHARMACEUTICALS

Injectables, parenterals, vaccines, drug delivery systems, skin treatments, inhalers, cough syrups, ophtalmic suspensions,...

FOOD & BEVERAGES

Soft drinks, flavor emulsions, beverages, milk and dairy products, vegetable drinks, plant protein, wine & beers, additives, gums and stabilizers...

HOME & PERSONAL CARE

Creams & lotions, moisturizers, sunscreens, detergents, fragranced formulations, cleansers, foundations, make up, nail polishes...

COATINGS, PAINTS & INKS

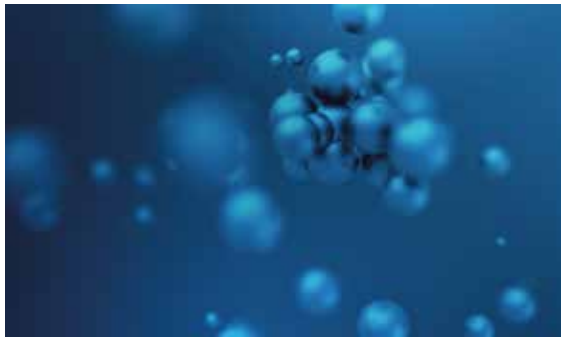
Water-based, solvent-based, resins, varnishes, inks, primers, protective and special coatings...

OIL & LUBRICANTS

Water-in-oil demulsification, enhance oil recovery, drilling fluids, crude oils, heavy fuels, fuel & oil additives, metal working fluids, lubricating agents...

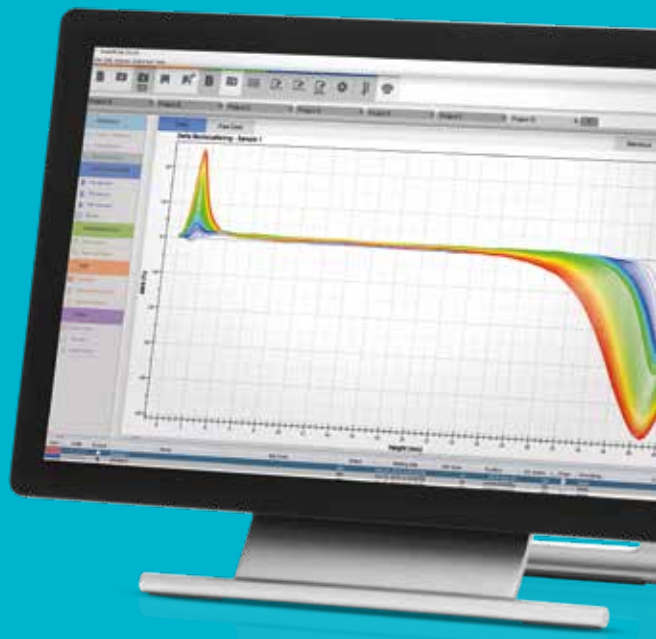
BATTERY & ELECTRONICS

Anode & cathode slurries, CMP slurries, multilayer capacitors, LCD and LED display...



AND MANY MORE

Agrochemicals, building materials, colloidal suspensions, nanoparticles...



VISIT OUR APPLICATIONS DATABASE

Interested to hear more about applications in each industry, visit the Microtrac website

START EXPLORING!

www.microtrac.com/applications

SHELF LIFE & DISPERSIBILITY
ANALYZERS TURBISCAN

ACCESSORIES AND OPTIONS

STANDARD VIALS (20 mL)

Cylindric glass vials have a recommended volume of approximately 20 mL. They are disposable to avoid chemical or bacterial contamination and decrease labor costs for washing and drying. The vials are closed thanks to a cap and a disposable PTFE seal to prevent evaporation in case of elevated temperatures. These vials are meant to reproduce your visual stability test.

SMALL VOLUME (4 mL)

Small sample volume? No problem. Small-volume vials and specific adapter are available. The measurement can be done with as few as 2 mL. Another benefit: the sample can be fully recovered, Turbiscan measurement is non-contact/non-destructive.

ON-DEMAND VIALS

You have special needs, and we understand this! Our development team loves challenges: on-demand adapters can be offered (pre-filled syringes, pressurized vials,...). Perfect to study the stability in specific conditions (pressure) or for Quality Control.

CORING VIALS

Some samples are not easy to transfer or are too fragile to be poured. The coring vials set helps to go around this problem. With its open bottom (closed manually with a stopper), a sticky sample or foam can easily be sampled with the coring vials.

CALIBRATION STANDARDS

Each Turbiscan comes with a set of standards to check instrument calibration. The Turbiscan software (Turbisoft) guides you step-by-step and once the procedure is finished, the software gives a thumbs up. Test and results are saved, and instrument-checking procedure can be tracked.

TECHNICAL DETAILS

SPECIFICATIONS AT A GLANCE

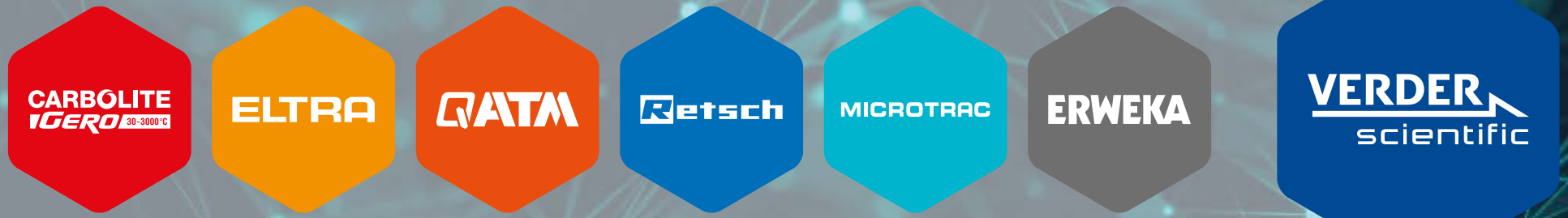




System	TURBISCAN LAB	TURBISCAN TRILAB	TURBISCAN TOWER	TURBISCAN AGS	TURBISCAN DNS
Measuring principle	Static Multiple Light Scattering (SMLS)				
Measurement type	Stability & Shelf Life Studies				Dispersiblity & Stability
Sample volume	2 -20 mL			20 mL	4 or 20 mL
Temperature range	RT – 60°C	20 – 60°C	4 – 80°C	RT – 60°C (3 racks)	RT – 60°C
Number of samples	1	1 – 3	1 – 6	54	1
Sample concentration	0.0001 – 95% v/v				
Reproducibility / repeatability on latex standards	+/-0.05%/0.05%			+/-0.1%/0.05%	
Acquisition scan step	20 µm			40 µm	
Automatic sample recognition (barcode)	✓	✓	✓	✓	–
Standards	ISO/TR 13097:2013, ISO/TR 18811:2018, ISO/TS 22107:2021, ISO/TS 21357:2022, ISO 13317				
Mixing function	–	–	–	–	Up to 2000 rpm
Circulation function	–	–	–	–	Up to 1000 Cps / 1000 mPas
Software	Turbisoft	Turbisoft Trilab	Towersoft	Turbisoft AGS	Turbisoft & Turbisoft Fast
Dimensions	26 x 28 x 25 cm	38 x 48 x 58 cm	145 x 75 x 85 cm	38 x 45 x 90 cm	70 x 63 x 52 cm
Weight	8 kg	35 kg	50 kg	80 kg	30 kg
CE Certified	✓	✓	✓	✓	✓

VERDER SCIENTIFIC – SCIENCE FOR SOLIDS

Microtrac is part of Verder Scientific, the scientific division of the Verder Group. Five more companies are part of the scientific division: Retsch, Carbolite Gero, QATM, Eltra and Erweka. Together we set new standards in the development and manufacturing of lab and analysis equipment, as well as sample preparation tools, which are used in areas such as quality control, research and development.



For more details about the extensive Microtrac product portfolio please visit our website: **www.microtrac.com**

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VERDER scientific

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