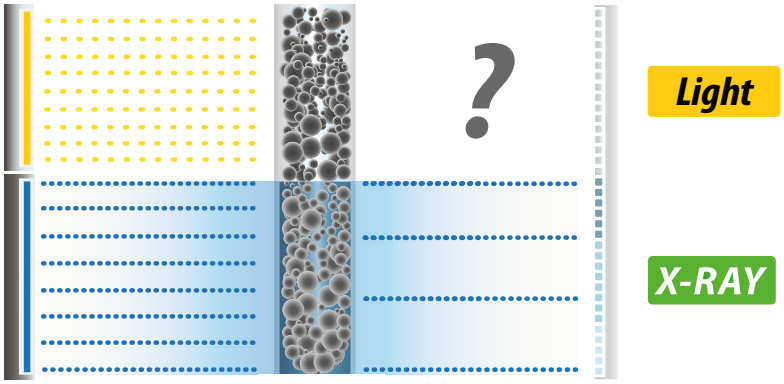
LUM

GRAVITY SEPARATION
& PARTICLE ANALYSER

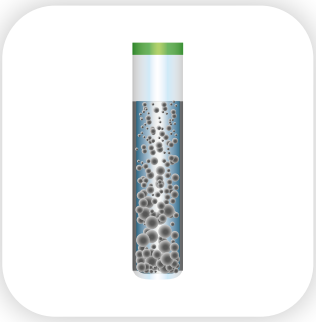
REVEAL WHAT LIGHT CAN'T.
ANALYSE WHAT MATTERS.

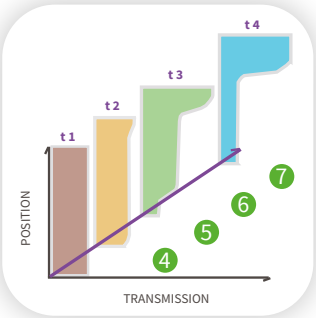
LUMiReader®
X-Ray 440

- PARTICLE SIZE DISTRIBUTION
- ACCELERATED STABILITY/ SEPARATION AT HIGHER TEMPERATURE
- CONCENTRATION GRADIENTS
- DISPERSIBILITY OF PARTICLES
- (IN-)HOMOGENEITY OF DISPERSIONS, POWDER MIXTURES & SOLID MATRICES



1 X-ray source 2 Sample 3 X-ray detector





1 X-ray source
2 Sample
3 Sensor
4 5 6 7 Kinetics of transmission/extinction

X-ray transmission for your material challenges

QUANTIFY STABILITY, SEPARATION AND CONSOLIDATION EVEN IN OPAQUE SYSTEMS

The LUMiReader® X-Ray is a gravity particle and dispersion analyser: to study dispersability, stability, separation, and consolidation phenomena for completely transparent to completely opaque emulsions or suspensions. For the first time, X-rays illuminate your sample instantaneously from top to bottom. Solve your most challenging inorganic material problems with complete insight. Go places light cannot.

Our patented solution combines X-ray vision with the proven STEP-Technology®, permitting highest spatial resolution, short sampling intervals and powerful detection technique. The LUMiReader® X-Ray creates monochrome and parallel X-rays[1] with the help of a special crystal, which transmits the entire sample cell[2] of 20 mm height.

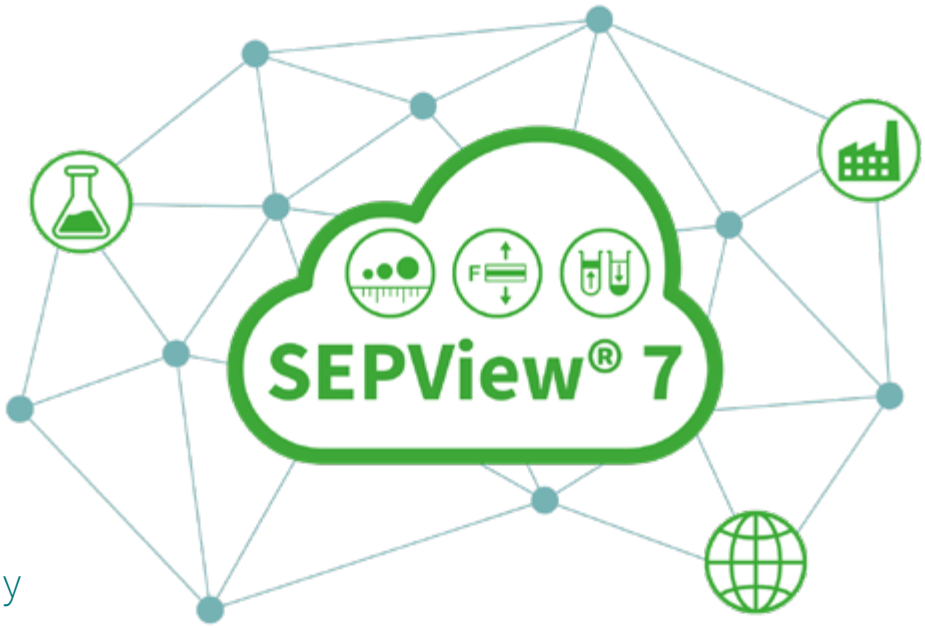
The X-ray line detector records the transmitted beam, giving an unprecedented resolution[3]. Instantaneous transmission profiles across your whole sample are converted into stability and separation rates. Particle concentration, sediment packing density can also be calculated based on the extinction profiles.

The obtained Space- and Time-resolved Extinction Profiles across your whole sample are converted into concentration gradients as well as stability and separation rates. Particle size distribution, particle density, volume concentration and sediment packing density can also be calculated based on the extinction profiles[4-7].

The LUMiReader® X-Ray allows you to characterize and optimize particle, formulation and product properties, from dispersibility via stability & separation to the quantification of separated phases and solid matrices.

Regardless of the shape or concentration of your dispersed particles and droplets. In-situ, real-time, non-invasive and non-destructive.

Typical applications are cosmetics, pharmaceutics, paint & pigments, construction materials and fillers, as well as mining, ceramics and petrol industry dealing with complex emulsions, slurries and sludges.



LUMiReader® X-Ray

RUNS ON SEPVIEW®

- Server-based, platform independent
- Plug & play, pack & go
- Real-time analysis during measurement
- Individual user customization
- Full SOP concept (Creation, capture, data analysis)
- Comprehensive database security & audit log
- Easier handling by 3D visualization
- Complies with 21 CFR Part 11

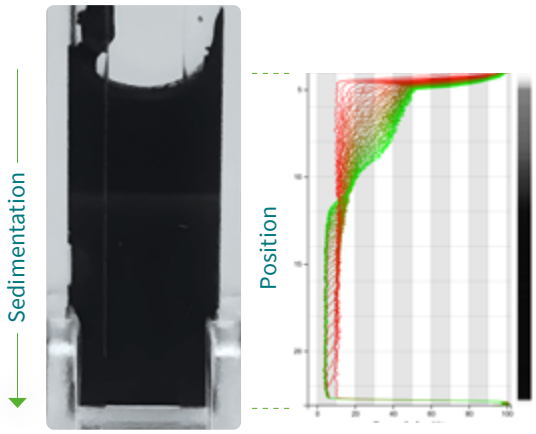
11 different Tools

TO UNDERSTAND (QUANTIFY) EASY, COMPLEX, SOPHISTICATED PRODUCTS & FORMULATIONS

- Dispersion & materials fingerprint
- First derivative analysis
- Front tracking analysis
- Integration analysis
- LUMView® Analysis
- Mass concentration
- Sediment height analysis
- Stability analysis
- Velocity distribution analysis
- Volume concentration
- Volume-weighted particle size distribution analysis

ILLUMINATE THE DARKEST DISPERSIONS

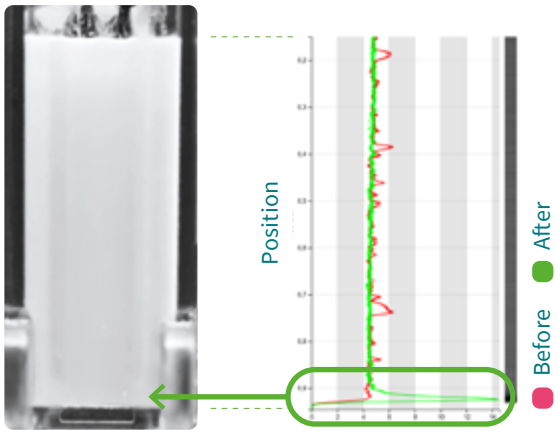
Real-time monitoring of battery paste and black mass during gravity sedimentation in original concentration.



Naked eye Transmission

CONQUER EVEN HIGHLY LIGHT-ABSORBING PRODUCTS

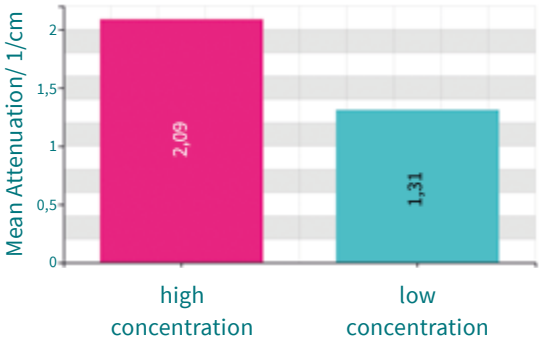
Fingerprinting of a topical formulation, e.g. with ZnO. Homogeneity before and consolidation after physically accelerated separation.

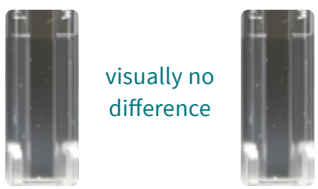


Naked eye Attenuation/ 1/cm

AQUEOUS SOLUTIONS OF NaCL

Discover what the naked eye can't quantify in transparent solutions



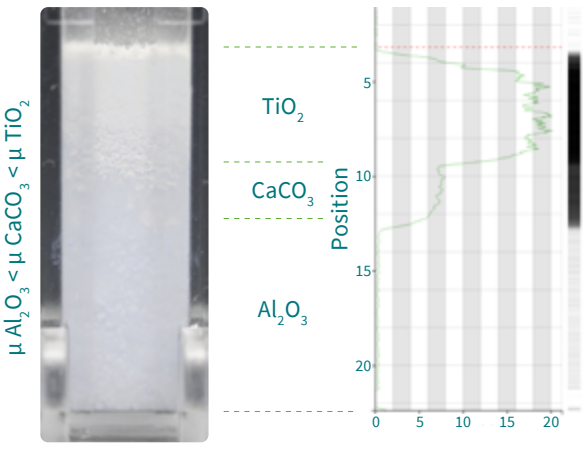


visually no difference

Naked eye Naked eye

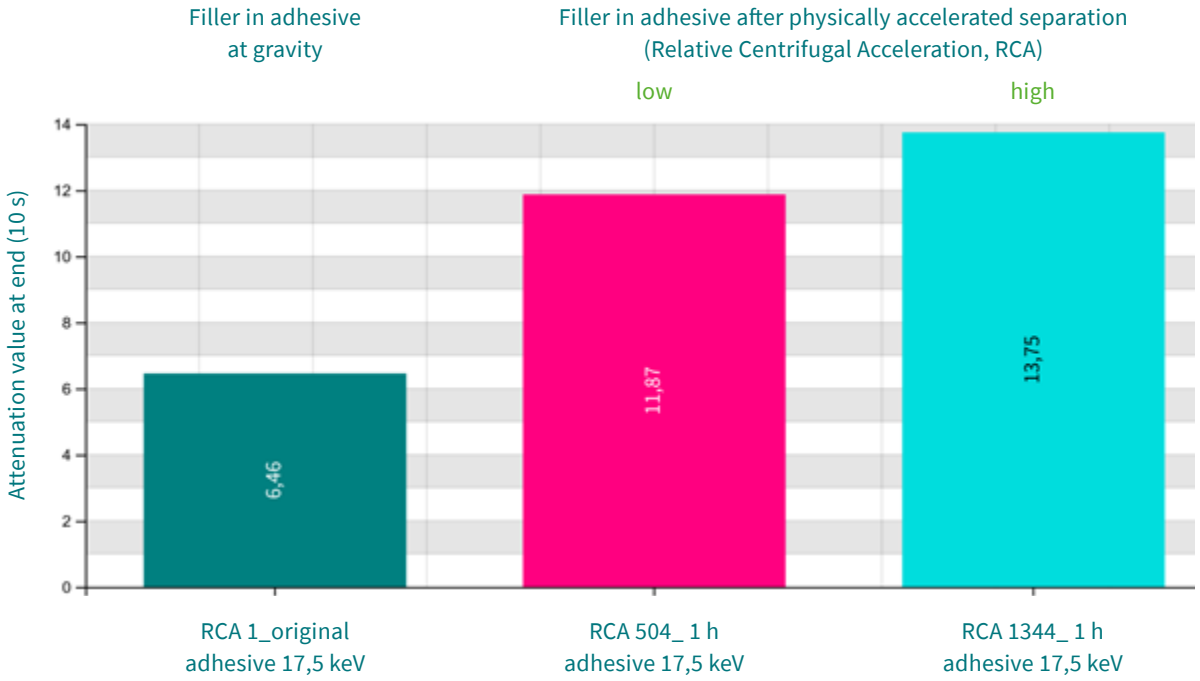
CHARACTERIZE POWDER COMPOSITION & HOMOGENEITY

Quantify powder dispersibility based on different attenuation coefficients.

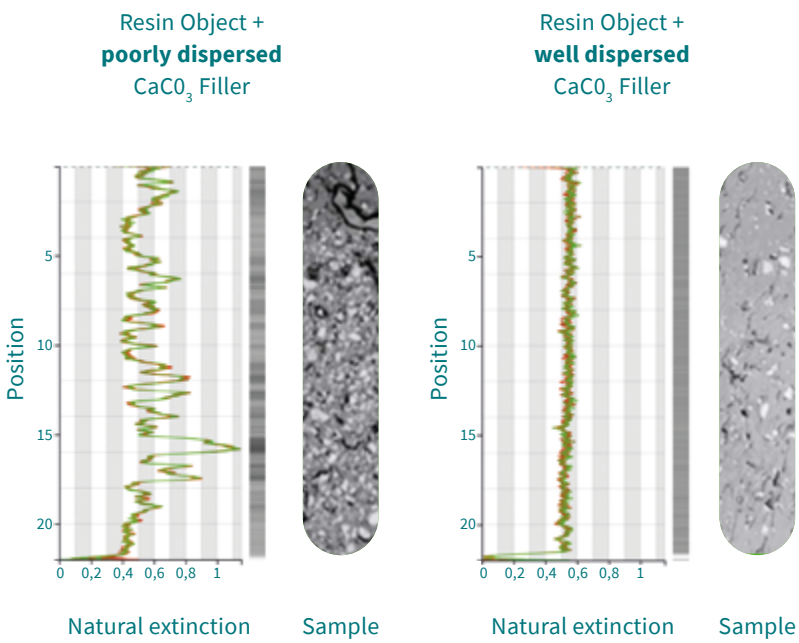


Naked eye Attenuation

SPATIALLY RESOLVED SEDIMENT CONCENTRATION & CONCENTRATION GRADIENTS



DISPERSED STATE OF SOLID OBJECTS



Quantification by standard deviation of mean natural extinction.

Discover these and further applications in the LUM literature database.

lum-gmbh.com/publications/literature-database.html

Accelerated Stability testing at gravity

LUMIREADER X-RAY 440

Storage and measurements at high temperatures are probably the most common means of accelerated stability testing at gravity for a wide variety of suspensions and emulsions. They are suggested or required by various standards and guidelines [1-4]. The LUMiReader X-Ray operates in the temperature range of 15–40 °C, for selected applications even up to 60 °C, and meets the requirements for cosmetics, food, drugs and pharmaceutical products, paints, and pigment formulations.

While previously changes had to be detected with the naked eye, resulting in quite long testing times, the combination of storage at higher temperatures and sensitive instrumental X-ray technology can significantly shorten temperature exposure times. Here, too, X-rays demonstrate their advantages over optical wavelengths in the visible and near-infrared wavelength range for highly concentrated and very turbid products as well as for transparent formulations with X-ray-sensitive ingredients. Transmission measurements based on STEP-Technology® once again demonstrate their advantages over near-surface methods and single-point measurements, as the sample is in focus from top to bottom and throughout its entire depth.

The typical procedure consists of very short measurements (typically 10 seconds) at a set time interval during storage at the high storage temperature and the combination of the measurement results in the software. This enables a high sample throughput.

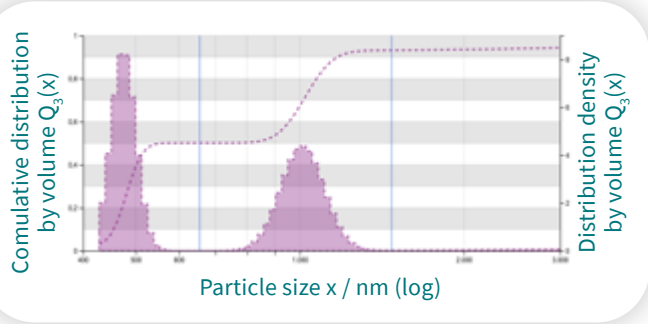
Although rather unusual, a sample can also be left undisturbed, free of mechanical vibrations, in the device at the selected high temperature for a very long period of time and measured at predefined intervals.

Particle Size Distribution

Advanced Particle Sizing with the LUMiReader® X-Ray

X-RAY EXTINCTION FOR PARTICLE SIZING BEYOND OPTICAL LIMITS

Particle sizing of inorganic materials with the LUMiReader® X-Ray (LRX), all advantages of separating techniques apply, is based on monochrome X-ray transmission, providing a powerful alternative to optical methods that struggle with opaque or highly concentrated dispersions. By applying Lambert-Beer's law, the instrument translates X-ray attenuation into direct information about the volume concentration of suspended particles, even in samples that are impenetrable to visible or near-infrared light.



Analysis of particle size distribution follows ISO 13317-3:2001 "Determination of particle size distribution by gravitational liquid sedimentation methods; Part 3: X-ray gravitational technique". Display the raw data and apply several fit functions.

ADVANTAGES OF PARTICLE SIZING WITH LRX

1. Particle and droplet sizing over whole sample (STEP).
2. True raw data – direct physical measurement.
3. From nm to µm same principle.
4. Multimodal systems with high resolution.
5. Higher concentrations than other techniques.
6. No restrictions regarding liquid continuous phase (closed cell).
7. No refractive indices required for volume-weighted particle size distribution.

[1] ISO/TR 13097:2013 (E), Chapter 4.4 Procedures to accelerate the evaluation of long-term stability: https://www.iso.org/standard/52802.html [2] ISO/TR 18811:2018(E), Chapter 4 Basic principles of cosmetic stability: https://www.iso.org/standard/63465.html [3] https://www.unicef.org/supply/media/3391/file/NSF-2019-Stability-Study-Requirements.pdf (25.3.2024) [4] WHO Technical Report Series No. 962, 2011, Annex 3, Guidelines on stability evaluation of vaccines https://www.who.int/biologicals/vaccines/Annex_3_WHO_TRS_962-3.pdf?ua=1 (20.5.2020 10:49)

Profit from the following

GOOD TO KNOW
Extremly high concentrations

- In-situ analysis of transparent as well as opaque dispersions
- No dilution of emulsions or suspensions
- Signal does not depend on particle shape
- See/understand complex dispersion behaviour
- Study the various instability mechanisms
- High resolution of phase separation of multicomponent systems
- Determination of particle size distribution and separation velocity distribution
- Detect concentration gradients in phases and sediment
- Determine mean and space resolved sediment packing densities
- Endless monitoring of sample behaviour for long-time storage information
- Use any continuous phase of dispersing agent
- Real time, non-invasive and non destructive
- High-end analyser for QC, process monitoring and R & D

Selected Application Areas

- Abrasives
- Agrochemistry
- Batteries & fuel cells
- Carbon black (modified)
- Catalysts
- Clays
- Coated particles
- Cosmetics
- Ceramics
- Construction materials
- Ferrofluids
- Fillers
- Inks
- Laqueurs
- Lubricants
- Magnetic particles
- Metals
- Minerals
- Nanosuspensions
- Oil sands
- Pharmaceuticals
- Paints
- Paper Dispersions
- Pigments
- Rigid foams
- Silicone oil emulsions
- Sludges
- Solid electrolytes
- Titanium dioxide
- Wastewater

Specifications

Technical specifications LUMiReader® X-Ray 440

Measurement principle	Monoenergetic X-ray attenuation / transmission
Phase separation	Low to high concentrated dispersions (transparent or opaque)
In situ sediment analysis	Packing density & structure
Stability analysis observation time	1 s to ∞
Particle size distribution range	70 nm to 100 µm
Consolidation measurements	Typically 10 seconds, also in combination with LUMiFuge & LUMiSizer
Conformity	ISO 13317-3, ISO 18747, ISO/TR 13097, ISO/TR 18811, CFR 21 Part 11
Samples	Suspensions, emulsions, suspo-emulsions, sludges, slurries, foams, chemical solutions, solid flat objects, powders
Channels	One
Volume	0.2 ml to 1.5 ml
Dispersion concentration	0.015 Vol% to 75 Vol%
Radiation source	Molydenum X-ray tube, 17.48 keV
Temperature control	15 °C to 40°C, specific applications have successfully been tested at 60 °C (with thermostat)
Cells	Different materials, optical pathlength 1 mm – 10 mm
Dimensions (WxHxD), Weight	47 x 24 x 52 cm, 25 kg
Power supply	Main power connection = 24 V DC, power consumption max. 9.2 A / 221 W
Safety	Directive 2013/59/EURATOM Full protection device according to § 21 StrlSchV
Radiation control requirements	none* *Type approval according to German X-ray ordinance (PTB 1/25 V StrlSchG)

Find out more:
www.lumireader-xr.com

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LUM **The** NEXT STEP **in Dispersion Analysis & Materials Testing**

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