MultiScan MS 20

Dispersion stability analysis system

dataphysics

Dispersion stability analysis

Dispersions are multi-phase mixtures consisting of substances that are insoluble in one another. One phase is the continuous phase in which small fragments of the other phase are dispersed. A **suspension** consists of a liquid continuous phase and dispersed solid particles. In an **emulsion** the dispersed particles are small droplets of another liquid, and a **foam** consists of a liquid continuous phase and dispersed gas bubbles.

Dispersions are encountered in everyday life in many different products, ranging from **salad dressings** and **cocktails** in the food sector, **emulsions** and **creams** in cosmetic and pharmaceutical products to multi-phased **cleaning agents**, **emulsion paint** or **seal slurry** in the building industry, to name just a few examples.

For all these products the **dispersion stability** is an extremely important factor that has to be analysed and optimised during product development.

Over time destabilisation processes take place inside dispersions: the dispersed particles can **sediment** or **cream** due to gravity. Moreover phase separation occurs because of the interfacial tension: the dispersed particles **cluster** or **merge** in order to minimise their interfacial area to the surrounding continuous phase.

The **dispersion stability analysis** utilises an optical measuring procedure: with two light sources and a detector, the light **transmitted** through and **scattered back** by the sample is analysed.

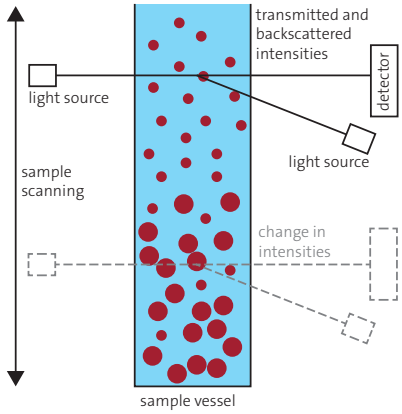
The transmission and backscattering intensities directly depend on the number, size and type of dispersed particles. Hence the light intensity changes while the dispersion destabilises. For example, particles disappear from the light path due to **sedimentation** or become bigger due to **clustering**.

Stability analysis tracks these changes by scanning the sample repeatedly for a certain experiment duration. During the measurement the whole sample height is scanned, hence both **global** and **local changes** in the sample are detected.

SMLS — Static multiple light scattering

The MultiScan MS 20 performs optical stability testing using the static multiple light scattering (SMLS) method. This method allows even the smallest changes to be detected

To conduct this method, the liquid sample is placed in a measurement tower. The measurement tower contains two light sources and a light detector. One light source is located opposite the detector — the detector detects the transmitted light. The second light source is located next to the detector — the detector detects the backscattered light. The detector and light sources scan the sample from bottom to top at regular intervals. This allows changes in the transmitted and backscattered light to be determined in spatial and temporal resolution.



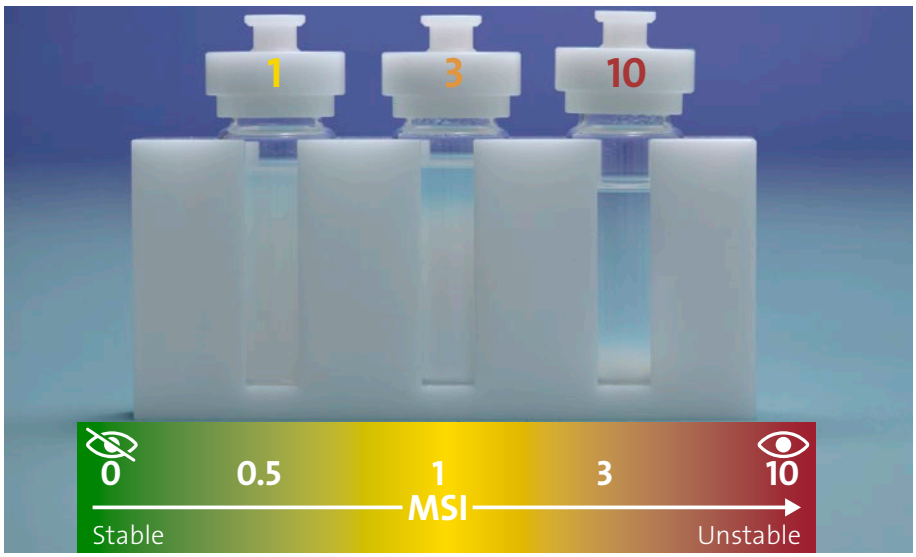
Measuring principle of the MS 20

MSI — MultiScan Stability Index

To facilitate the comparison of different formulations, DataPhysics Instruments has introduced the MultiScan stability index (MSI). To calculate the MultiScan stability index, an optical stability analysis must be performed using the static multiple light scattering (SMLS) method (see box on the left).

The MultiScan stability index consists of a single number that describes the overall mixture stability of the sample. The MultiScan stability index represents an aggregation of all temporal and spatial fluctuations in the signals for both transmitted and backscattered light. To simplify the interpretation of the MultiScan stability index, the MultiScan software features a scale that classifies the value. The scale is coloured from green to red, which allows for easy interpretation of the results. This scale is based on an empirical analysis of a database containing hundreds of measurements.

Interpreting the MultiScan stability index is very simple: the closer the value is to zero, the more stable the sample is. The higher the MultiScan stability index, the less stable the sample is. The MultiScan stability index allows for a direct comparison of the mixing stability of different formulations. Since the MultiScan stability index consists of a single number, it is immediately clear which of the different formulations is the most stable in comparison.



The MultiScan stability index describes the overall mixture stability of the sample

MultiScan MS 20

The MultiScan MS 20 is the measuring device for the automatic optical dispersion stability analysis, which is **fast**, **sensitive**, **non-destructive** and can measure samples in their **original concentration** and under **realistic storage conditions**. Hence, a variety of multi-phase dispersions, in particular **suspensions and emulsions**, and their time- and temperature-dependent destabilisation mechanisms can be comprehensively characterised.

The base unit of the MS 20 features an **integrated touch screen** that displays status information and can be used to control important base functions. Additionally it is possible to register the studied samples, fast and conveniently, with the **built-in** or an optional handheld **barcode scanner**. The MS 20 uses **up to six independent ScanTowers** for the measuring process. Hence, samples can be individually analysed at different temperatures and with different measuring parameters.

The temperature inside the ScanTower **ST-TEC** is controlled using an electric resistance heater and a liquid counter-cooling. This allows for measurements in a **temperature range of -10 °C to 80 °C**. Temperatures below 4 °C require an optional thermal insulation sleeve. Due to the possibility of using several ScanTowers on one MS 20, samples can be analysed in short- and long-term experiments side by side.

The MS 20 uses screw cap glasses with a special cap as sample containers for **easy insertion** into the measuring chambers of the ScanTowers. Using adapters sample containers of various dimensions and with **disposable glass vials** can also be used to facilitate measurements with reduced sample layer thickness or with hard to clean samples.

MS 20 with six scan towers ST-TEC

MSC Software

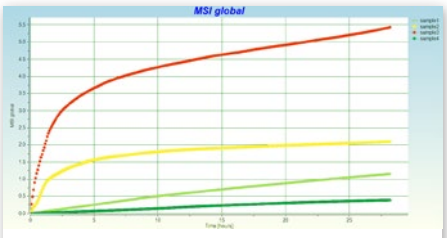
The MultiScan MS 20 is operated using the dedicated MSC software. It supports the user during the set-up of a measurement, when interpreting results, and with its special features. The software is designed for Microsoft Windows®.

Easy set-up of measurements
- automatic configuration of all six sample chambers, called Scan Towers, barcode scanner support, barcode label generator
- software assistant for guided setup and data analysis; measurement templates and customizable methods
- seven scanning modes for automated long-term and temperature-controlled measurements
- optional user management and socket for external devices (e.g. robot for sample routing)

Straightforward results
- graphical display of transmitted and backscattered light, as well as temperature data, in absolute or relative view
- overlay option for speedy comparison of multiple measurement files

Special features
- the MultiScan stability index: single-value parameter for ranking sample stability
- kinetics analysis of sedimentation, creaming, agglomeration, and coalescence
- Mie-theory–based evaluation: mean free path, particle or droplet diameter, volume concentration, as well as refractive index
- Stokes-theory–based evaluation of the particle and droplet size, concentration, density differences, and solvent viscosity
- determination of initial particle and droplet size distributions (PSD) using mono- and polydisperse distribution models (normal, log-normal, RRSB, and GGS)
- determination of the separability number according to ASTM D7061 for evaluating heavy fuel oil stability reserve
- optional: conversion into turbidity units – such as FNU, FTU, NTU, EBC, TUF, FAU – based on ISO 7027 and DIN EN 27027

ScanTower ST-TEC with optional thermal insulation sleeve



Stability analysis using MSC software

Technical data

Sample containers	reusable (SC xx) and disposable (SC xxD) glass sample containers in various sizes				
	SC 20	**SC 20D**	**SC 15**	**SC 10**	**SC 10D**
scanned volume	27 ml	27 ml	6 ml	2.8 ml	2.7 ml
inner diameter	25 mm	25 mm	12 mm	8 mm	7.9 mm
Sample properties					
mean size of dispersed parts	10 nm ... 1 mm				
volume concentration of dispersed parts	0.0001 ... 95 %				
Reproducibility	0.05 %				
Scanning drive					
Scan range	0 ... 56.5 mm				
Max. scan interval resolution	5 µm				
Max. scanning velocity	12.5 mm/s				
Light source and detection	**ST-TEC/L1-IR**		**ST-TEC/L1-Blue**		
Source	Near-infrared LED		Blue LED		
Wavelength	870 nm		470 nm		
spectral FWHM	45 nm		35 nm		
Detection angle	0° transmission; 45° backscattering				
Temperature control	ST-TEC with integrated electric resistance heater and liquid counter-cooling				
Temperature range[1]	-10 ... 80 °C				
Temperature measurement	Pt100 sensor for -60 ... +450 °C ± 0.01 K; precision 1/3 DIN IEC 751 (±0.03%), class B				
Device control	via integrated touch screen and software				
Max. number of simultaneous samples	6				
Sample recognition	via integrated or optional handheld barcode scanner				
Compliance with international standards	ASTM D7061; ISO 13317; ISO/TR 13097; ISO/TR 18811; ISO/TS 21357; ISO/TS 22107				
Dimensions (L [mm] x W [mm] x H [mm])	295 x 260 x 165 (base unit MS 20) 130 x 98 x 275 (ScanTower ST-TEC)				
Weight	6.8 kg (base unit MS 20) 2.1 kg (ScanTower ST-TEC)				
Power supply	100 ... 240 VAC; 50 ... 60 Hz; max. 300 W				

[1] to reach temperatures below 4 °C the optional thermal insulation sleeve for the ScanTower ST-TEC is required

**For more information please contact us.
We will find a tailor-made solution to your surface chemistry requirements and will be pleased to provide a quotation, obligation-free, for your instrument system.**

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