Komplexní charakterizace nátěrů

Anna Kolouchová

Formulaction
Smart scientific analysis

Poskytujeme inovativní řešení pro charakterizaci materiálů: od analýzy částic, přes predikci skladovatelnosti až po charakterizaci struktury a reologického chování.

*Stabilita suspenzí a charakterizace **koncentrovaných** disperzí*

HQ v Toulouse, Francie, Pobočky v USA (Columbus, OH) a Německu (Munich) se zastoupením ve více než 40 zemích

TURBISCAN
STABILITY & SIZE

RHEOLASER
MICRORHEOLOGY

FLUIDICAM
RHEOLOGY ON CHIP

pragolab

Definice

Nátěry: Obecně

- **Dekorativní a estetický aspekt**

Barva, jas, struktura povrchu…

- **Poskytnutá a sdílená informace**

Psaní, vodící značky…

- **Ochrana**

Koroze, UV záření, chemikálie, vlhkost…

- **Funkční vlastnosti**

Smáčivost, lepivost, hrubost…

- **Zlepšení vlastností**

Mechanické, vodivost, impemeabilita…

TURBISCAN

Nátěry – výhody Turbiscanu

- Tato technologie pomáhá dosažení nejlepšího složení, urychlení screeningu, a při zajištění výzkumu a vývoje.

✓ **Fast Shelf-Life measurement**
Replace visual observation for stability testing

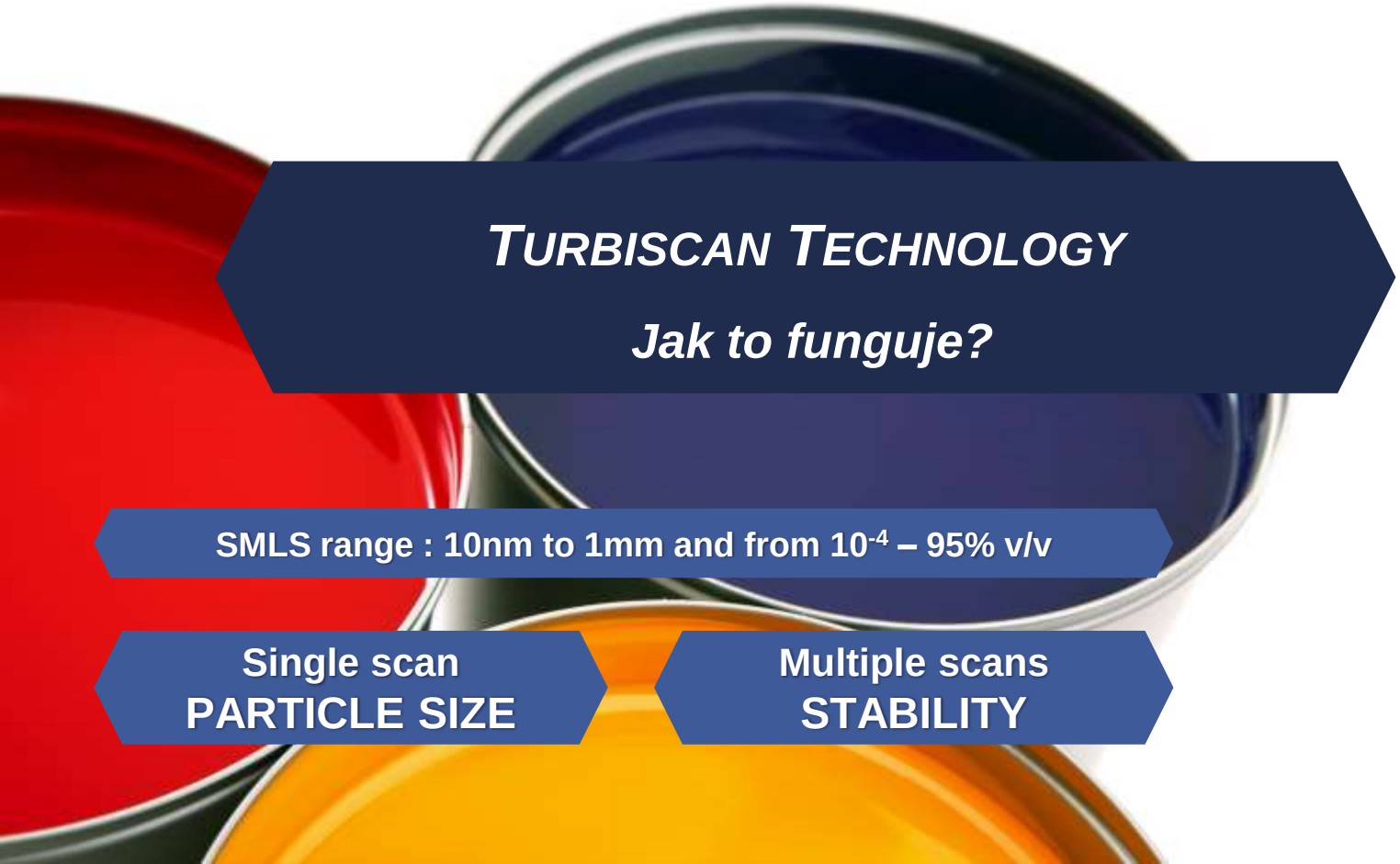
✓ **Sedimentation & Re-suspension study**
Does it sediment and is it reversible ?

✓ **Trustable data**
Visual observation are usually tedious and not objective. Other technics may require dilution, external mechanical forces…

✓ **Works on large range of formulation**
Water-Solvent based, low – high concentration, small particle size, low-high viscosity, paints, inks, varnishes,….

pragolab

- ***Turbiscan*® technology is based on *S*tatic *M*ultiple *L*ight *S*cattering (*SMLS*)**



TURBISCAN TECHNOLOGY

Jak to funguje?

SMLS range : 10nm to 1mm and from 10^{-4} – 95% v/v

Single scan
PARTICLE SIZE

Multiple scans
STABILITY

Non-Dilution & Native sample
Transparent Sample : Transmission (***T***)
Opaque Samples : Backscattering (BS)

Space resolution
Acquisition every 20µm

High resolution-SMLS
Sensible to smallest variation of particle size (***d***)
and concentration (***Φ***)

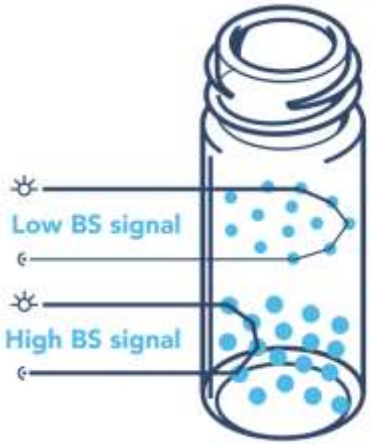
Turbiscan: Instrument
Technology and Theory

TURBISCAN
STABILITY & SIZE

Backscattering and transmission signals are dependent upon two factors:

d : particle size

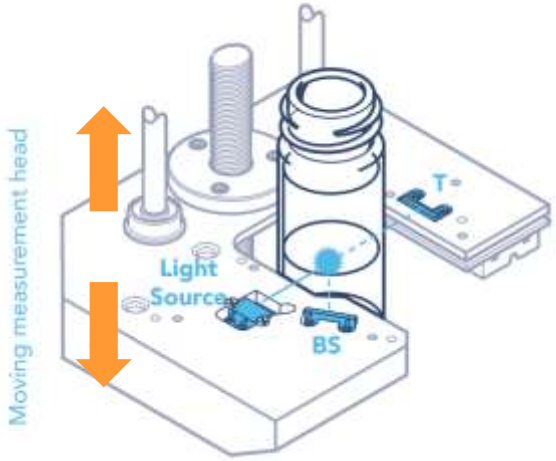
Φ : particle concentration



Repetition of the measurement provides:

Δd : change in particle size

Δ Φ : change in particle concentration



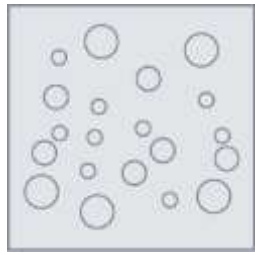
Scans are made **over the entire sample height** and **over time:**

Signal variation ➡ Variation in the sample ➡ Monitoring of stability

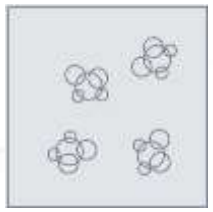
Physical Stability

Types of Destabilization Processes

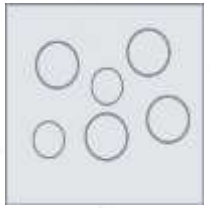
Time = 0



Homogeneous



Flocculation



Coalescence
Ostwald ripening

Particle size increase
↳ Influence of stabilization barrier and viscosity

OR

Time

Sedimentation

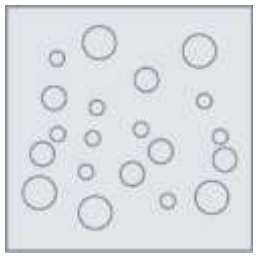
Creaming

Migration phenomena
↳ Influence of size and viscosity

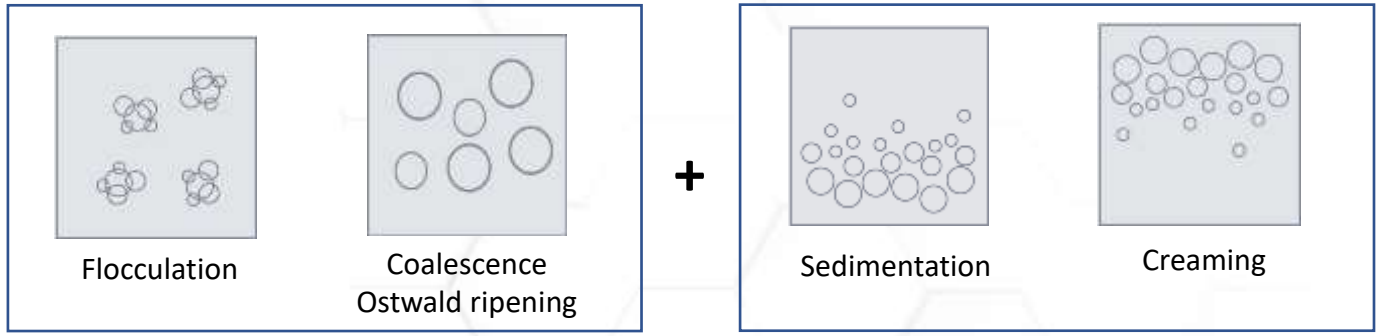
Physical Stability

Types of Destabilization Processes

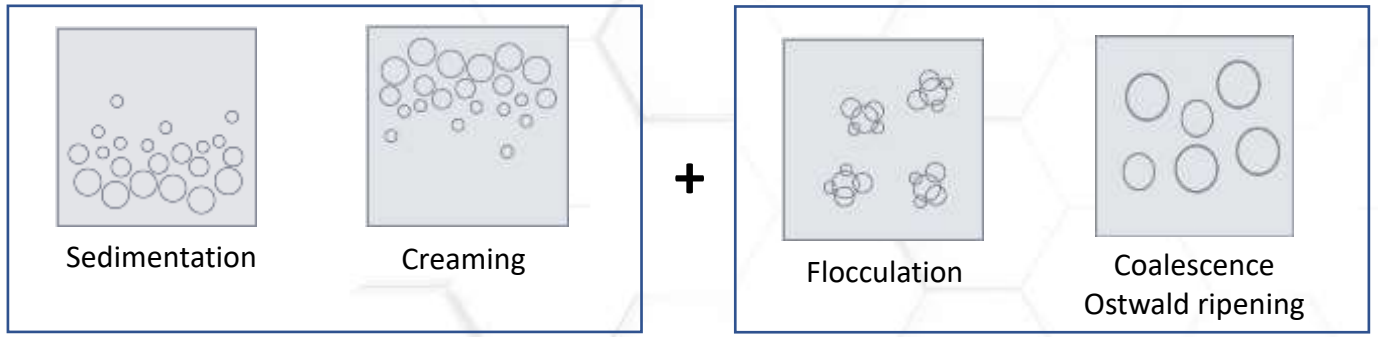
Time = 0



Homogeneous

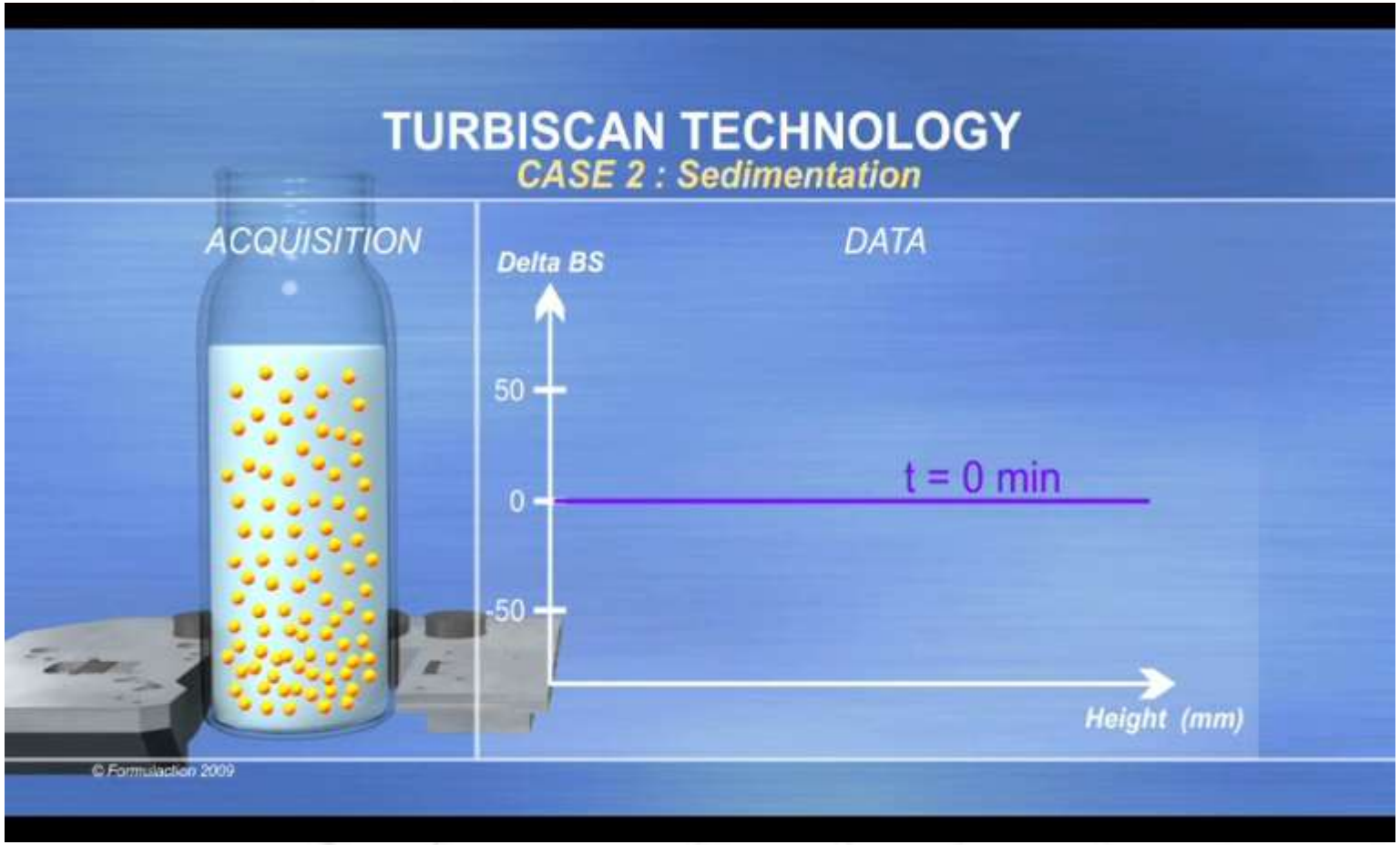


1st 2nd Time



Turbiscan: Data

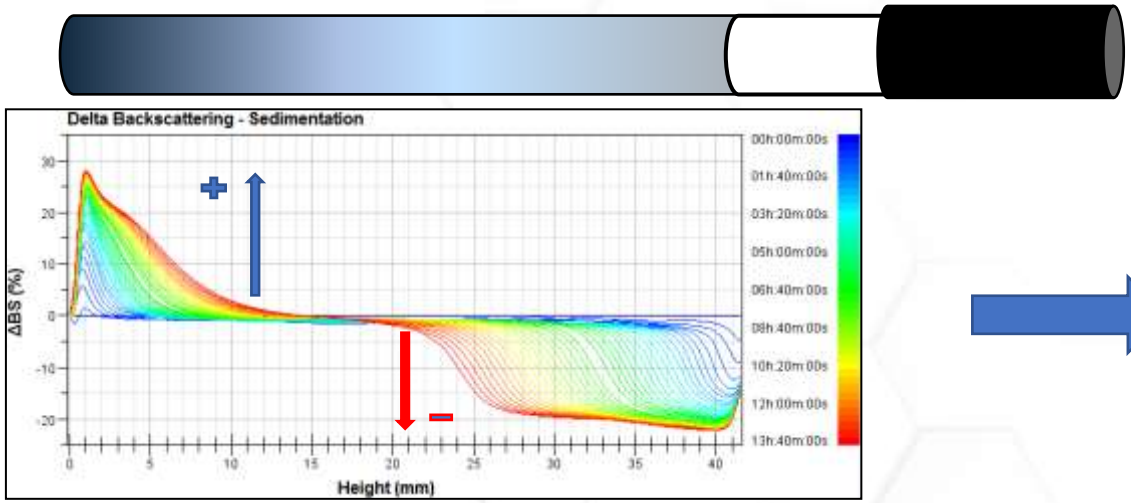
Sedimentation and Creaming

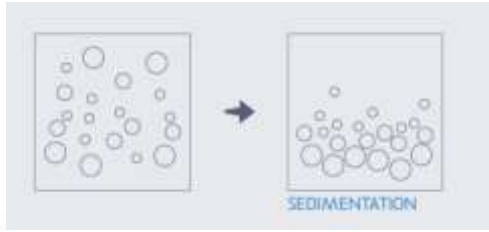


If local evolution of the signal → **PARTICLE MIGRATION**

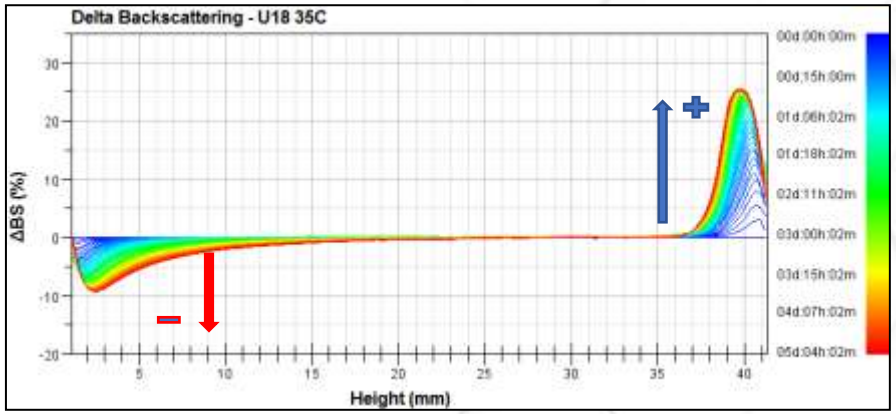
TURBISCAN TECHNOLOGY

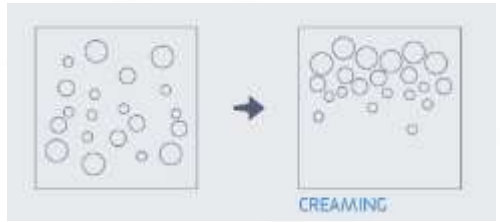
Particle migration detection





Sedimentation



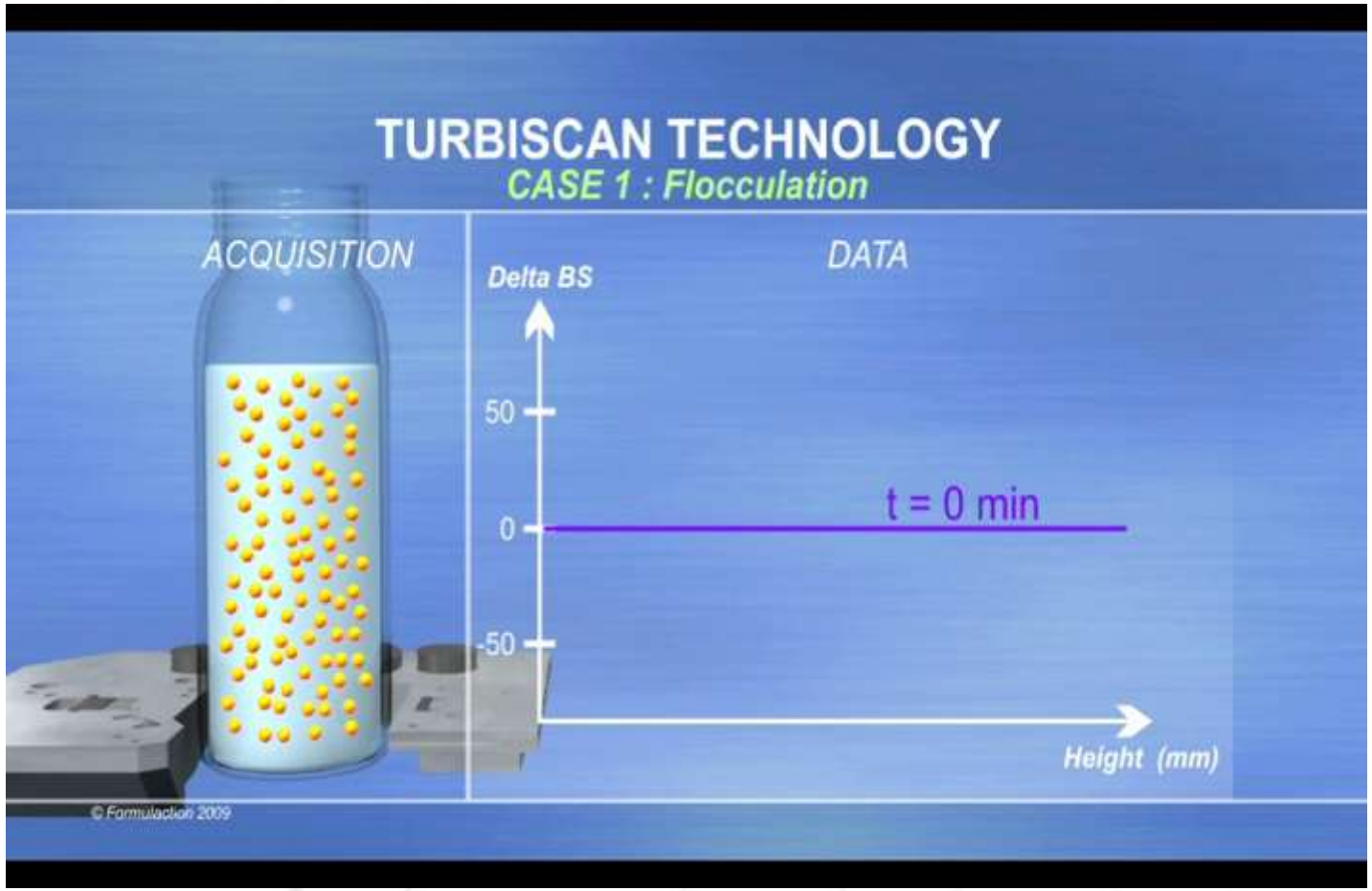


Creaming

⇒ Local evolution of the signal : *PARTICLE MIGRATION*

Turbiscan: Data

Flocculation and Coalescence

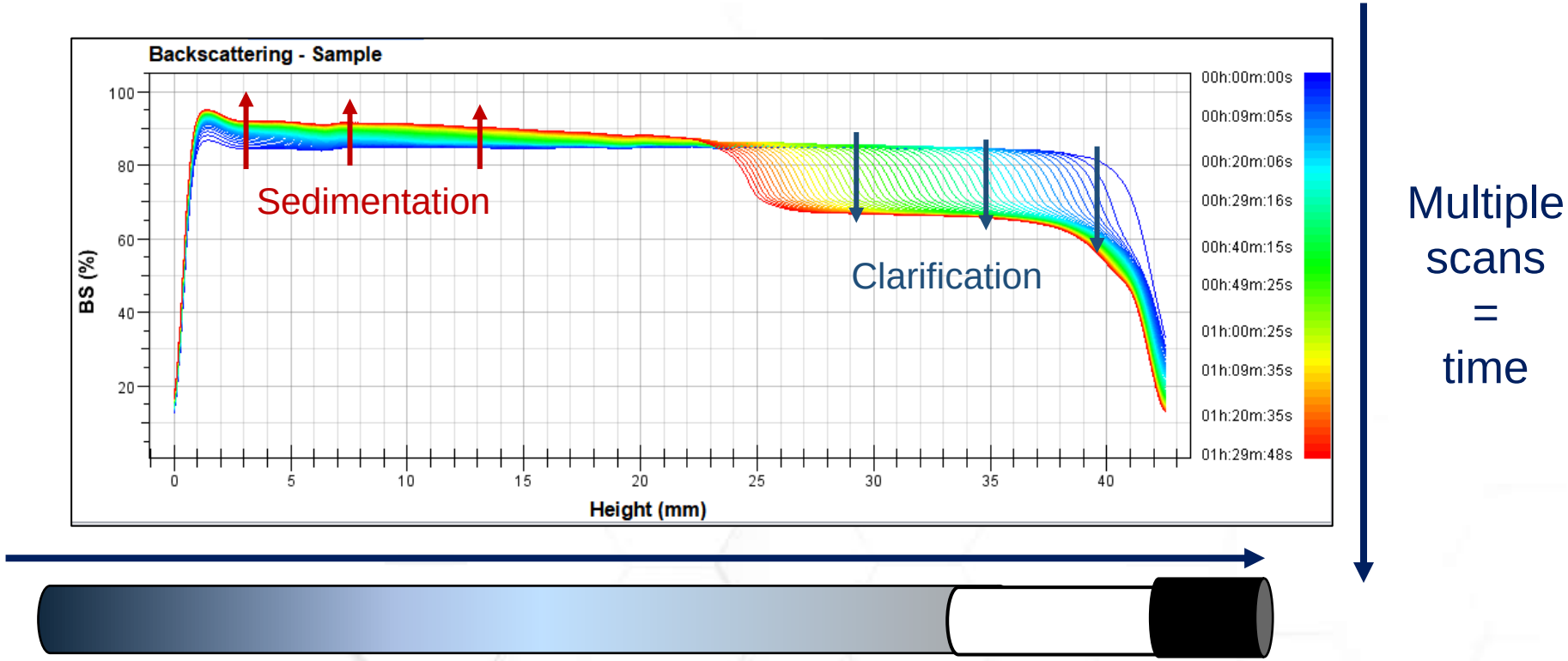


If <u>global</u> evolution of the signal → **Particle size variation**

TURBISCAN TECHNOLOGY

How it Works

- ***Turbiscan***® technology is based on ***S***tatic ***M***ultiple ***L***ight ***S***cattering (***SMLS***)



✓ **Multiple scans, if variations = DESTABILIZATION**

TURBISCAN TECHNOLOGY

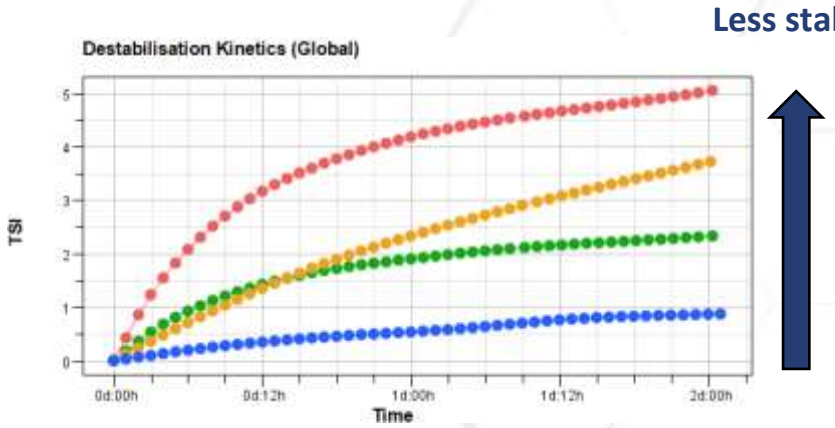
What is TSI

- **T**urbiscan **S**tability **I**ndex (**TSI**): A single number to compare sample and take the ***right decision***

$$tsi = \frac{1}{N_h} \sum_{t_i=1}^{t_{max}} \sum_{z_i=z_{min}}^{z_{max}} |BST(t_i, z_i) - BST(t_{i-1}, z_i)|$$

Cumulative sum of the differences between two scans

Higher the TSI, lower the Stability



Interest of the TSI

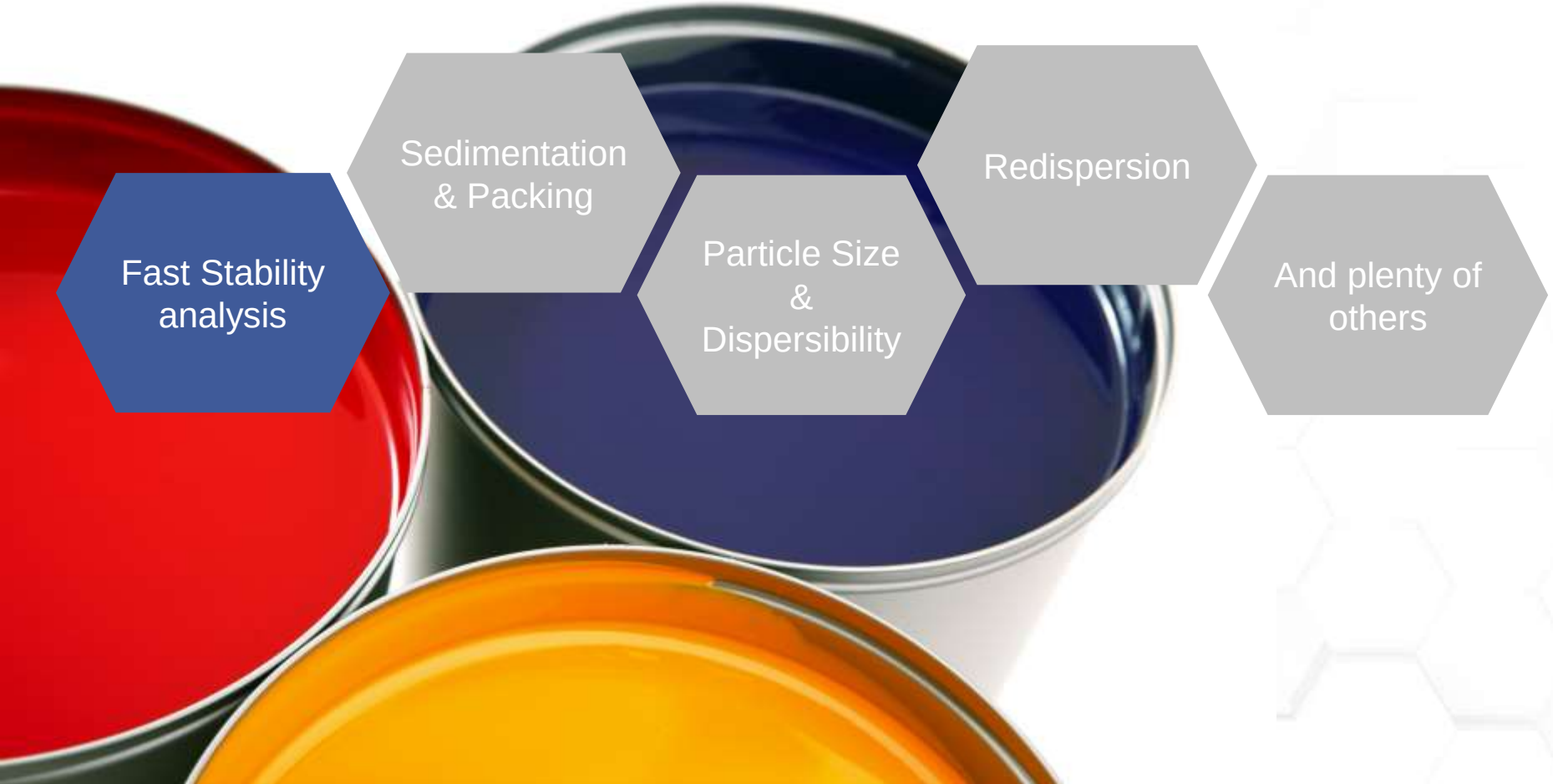
- ✓ **One-click** parameter
- ✓ **No additional** information required
- ✓ Takes in account **ALL DESTABILIZATIONS**
- ✓ **One** unique number to **rank** & **compare** samples
- ✓ Real-time histogram ranking and grading

Application available on www.formulaction.com

TURBISCAN

Coating industry - Application

– CASE STUDY- COATING INDUSTRY



Fast Stability analysis

Sedimentation & Packing

Particle Size & Dispersibility

Redispersion

And plenty of others

TURBISCAN

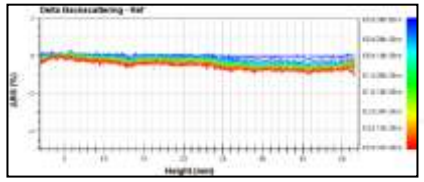
Case Study in Coating Industry

Fast Stability analysis

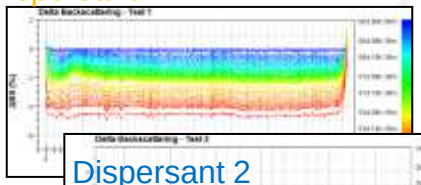
- Strategy to select the best dispersant with the Turbiscan ®

⇒ Step 1 : “Which dispersant is the best for my formulation ?”

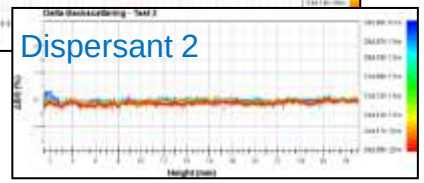
Reference

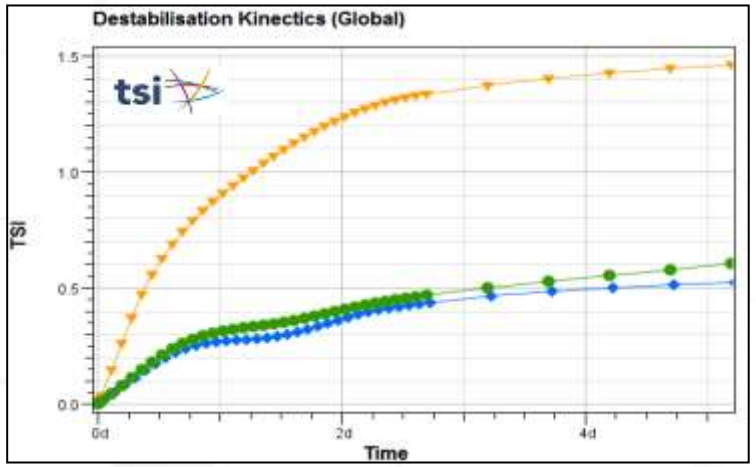


Dispersant 1



Dispersant 2





Dispersant 1

Reference
Dispersant 2

✓ Best choice : Dispersant 2

✓ Dispersant 2 : Similar Shelf life than Ref.

✓ Fast : Answer within **1 day**

Objective, **easy** and **one-click** stability test

TURBISCAN

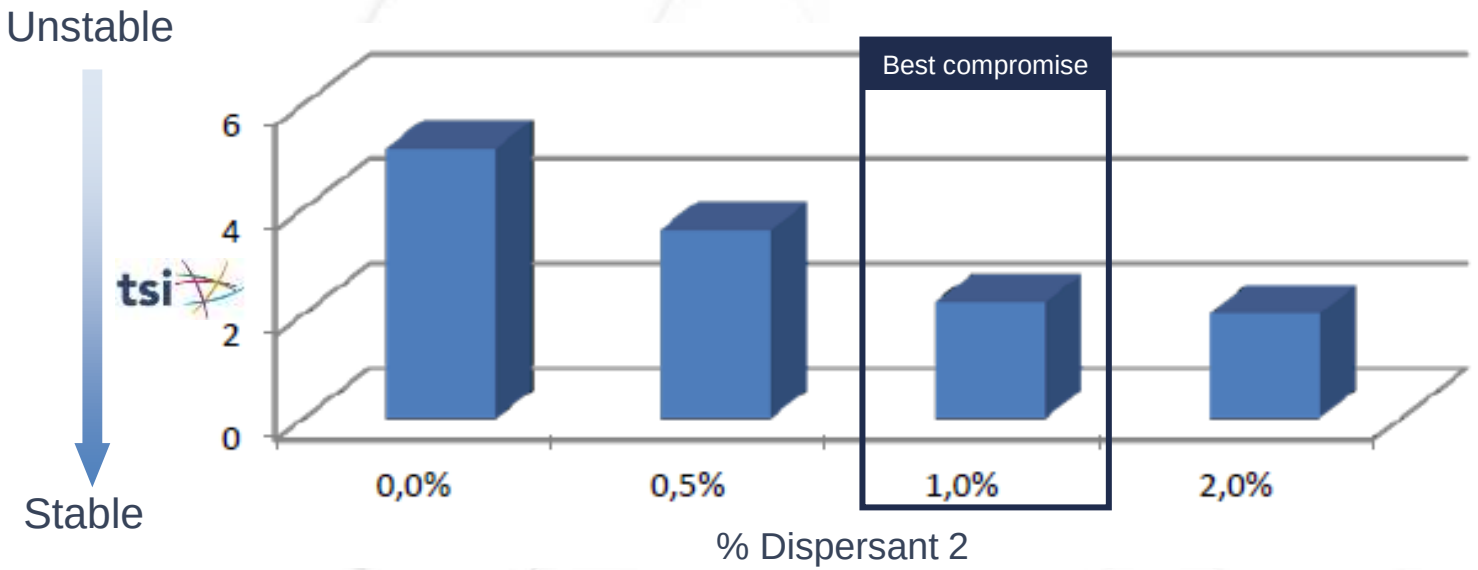
Case Study in Coating Industry

Fast Stability analysis

- Strategy to select the best dispersant with the Turbiscan ®

⇒ Step 2 : What is the optimum ratio between the performance/cost ?

- *Study the impact of the dispersant 2 concentration*



Optimize Formulation cost vs performance

TURBISCAN

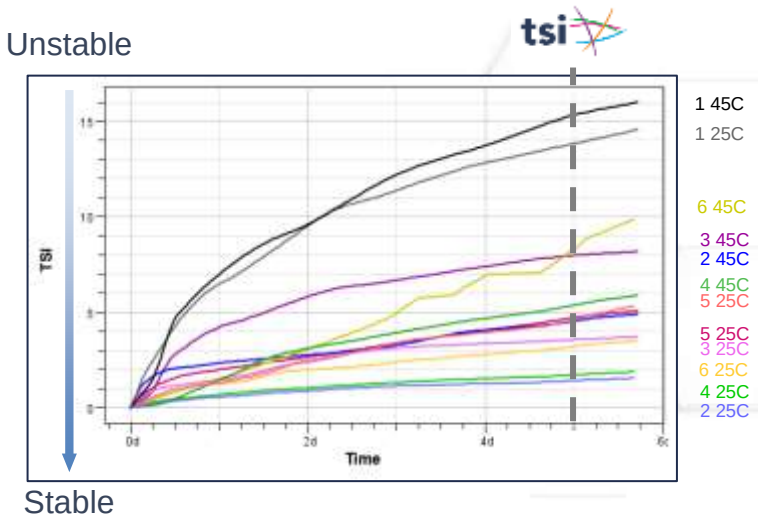
Case Study in Coating Industry

Fast Stability analysis

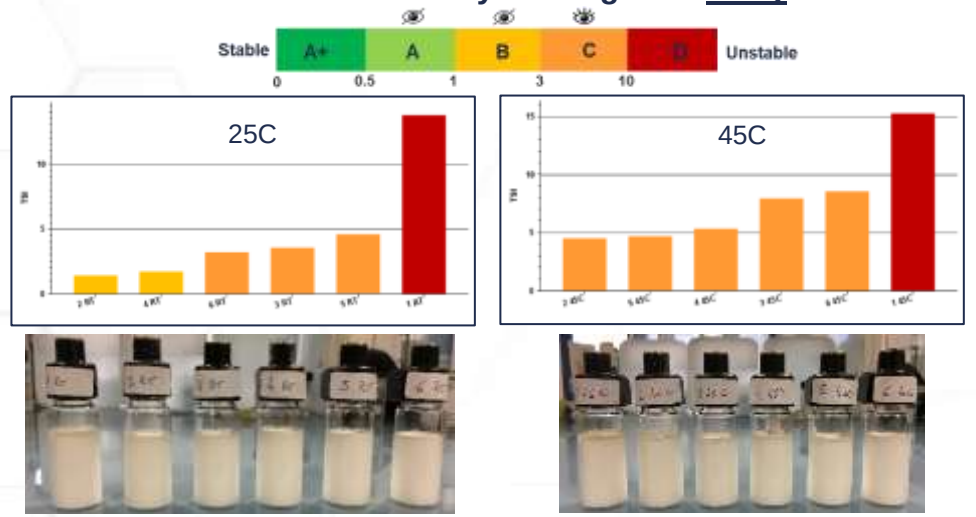
❑ Fast Formulation selection

⇒ How to speed up formulation selection process

- *6 white wall paint, study at 25C and 45C for 5 days with the Turbiscan*



Turbiscan Stability ranking after 5 day



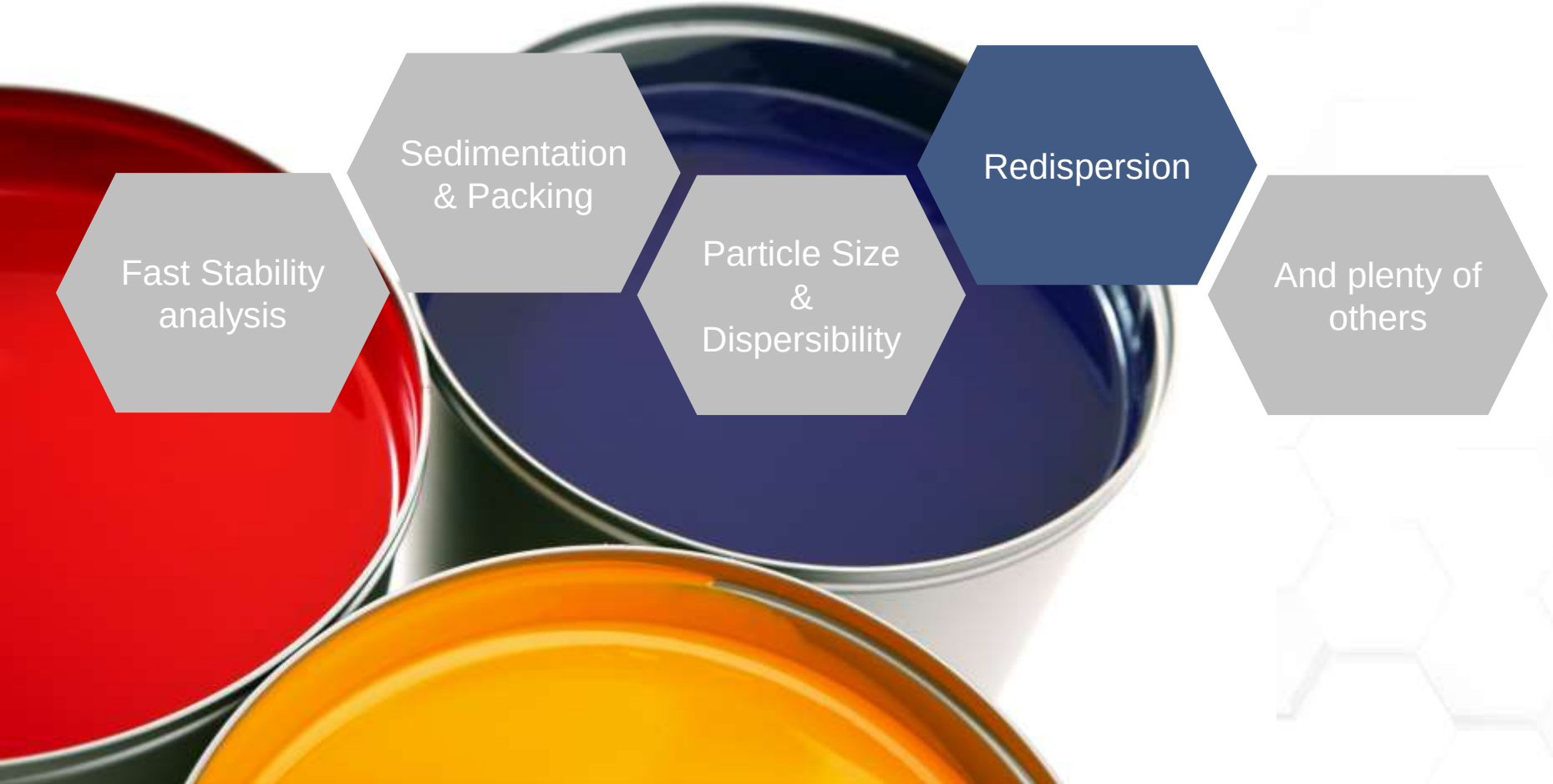
✓ Fast ✓ Quantitative ✓ Reliable

Fast and reliable decision making

TURBISCAN

Coating industry - Application

– CASE STUDY- COATING INDUSTRY



Fast Stability analysis

Sedimentation & Packing

Particle Size & Dispersibility

Redispersion

And plenty of others

TURBISCAN

Case Study in Coating Industry

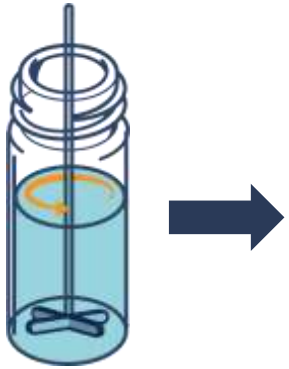
Dispersibility & Particle size

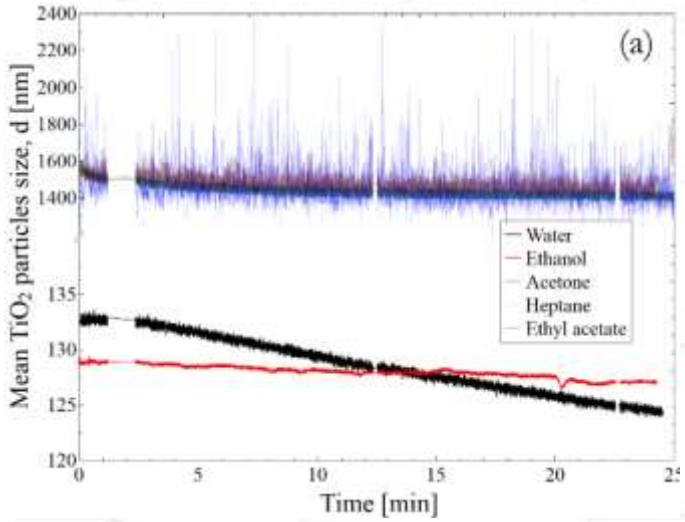
❑ Dispersibility

⇒ Online dispersibility study via dedicated mixing module for the Turbiscan vials

- *TiO2 dispersion at 25nm (manufacturer) – Test in different solvent (Labil H+, polarity).*

Add – Mix - Analyze





Acetone
Heptane
Ethyl acetate

X Poor dispersibility (d >> 25nm)
X Presence of agglomerates

Ethanol
Water

✓ Better dispersibility (d >> 25nm)
✓ Different behavior under mixing

✓ In situ measurement of Dispersibility (Particle size)

✓ Hansen type study possible , application note available !

TURBISCAN
STABILITY & SIZE

RHEOLASER
MICRORHEOLOGY

FLUIDICAM
RHEOLOGY ON CHIP

Analýza mikrostruktury vzorku:

- *Schnutí tenkých vrstev/tuhnutí lepidel*
- *Reologické vlastnosti v klidu (nulová smyková viskozita)*
- *Fázové přechody (potravinářské a farmaceutické aplikace)*

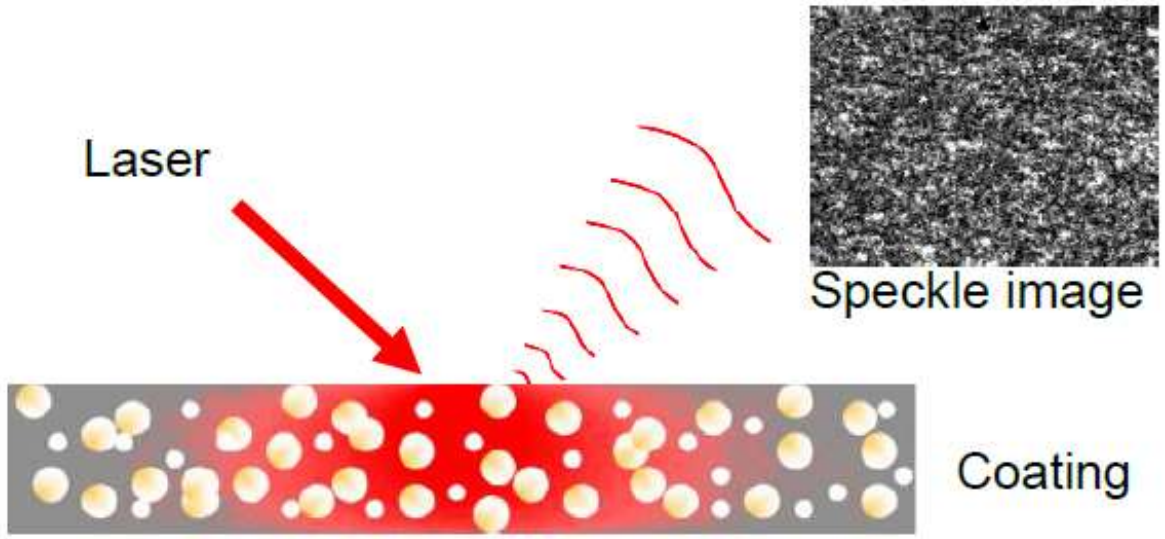


Figure 1. Diffusing Wave Spectroscopy set up

*scatterers: pigments, droplets, polymers, resins, fibers …

NEW: Rheolaser^{COATING} measurement can now be performed from RT up to **250°C** when associated with a heating chamber (fig 4.).

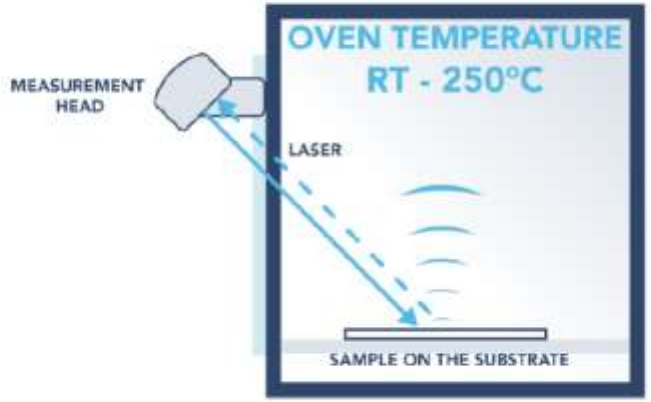


Figure 4: Temperature chamber for Rheolaser^{COATING}

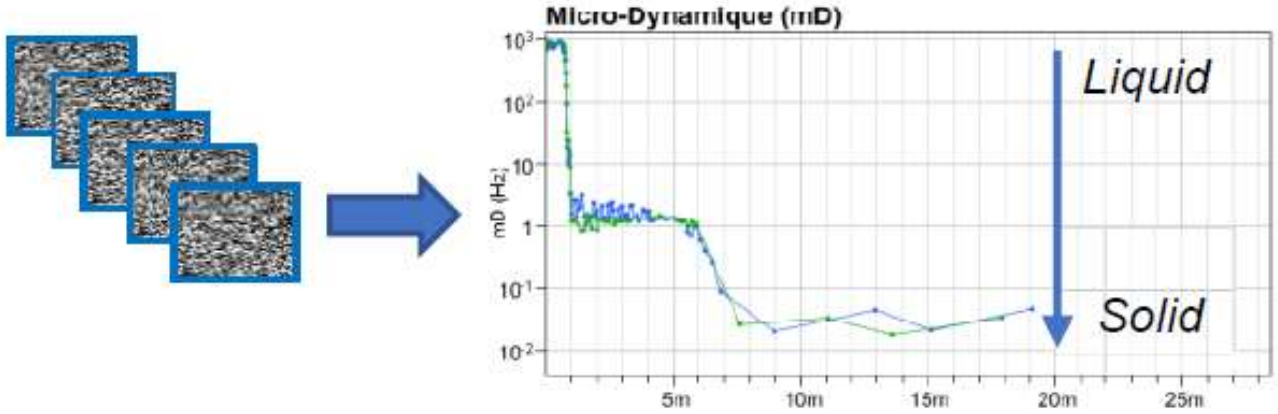


Figure 2: Exemple of Microdynamics (Hz) in function of time for a water-based paints.

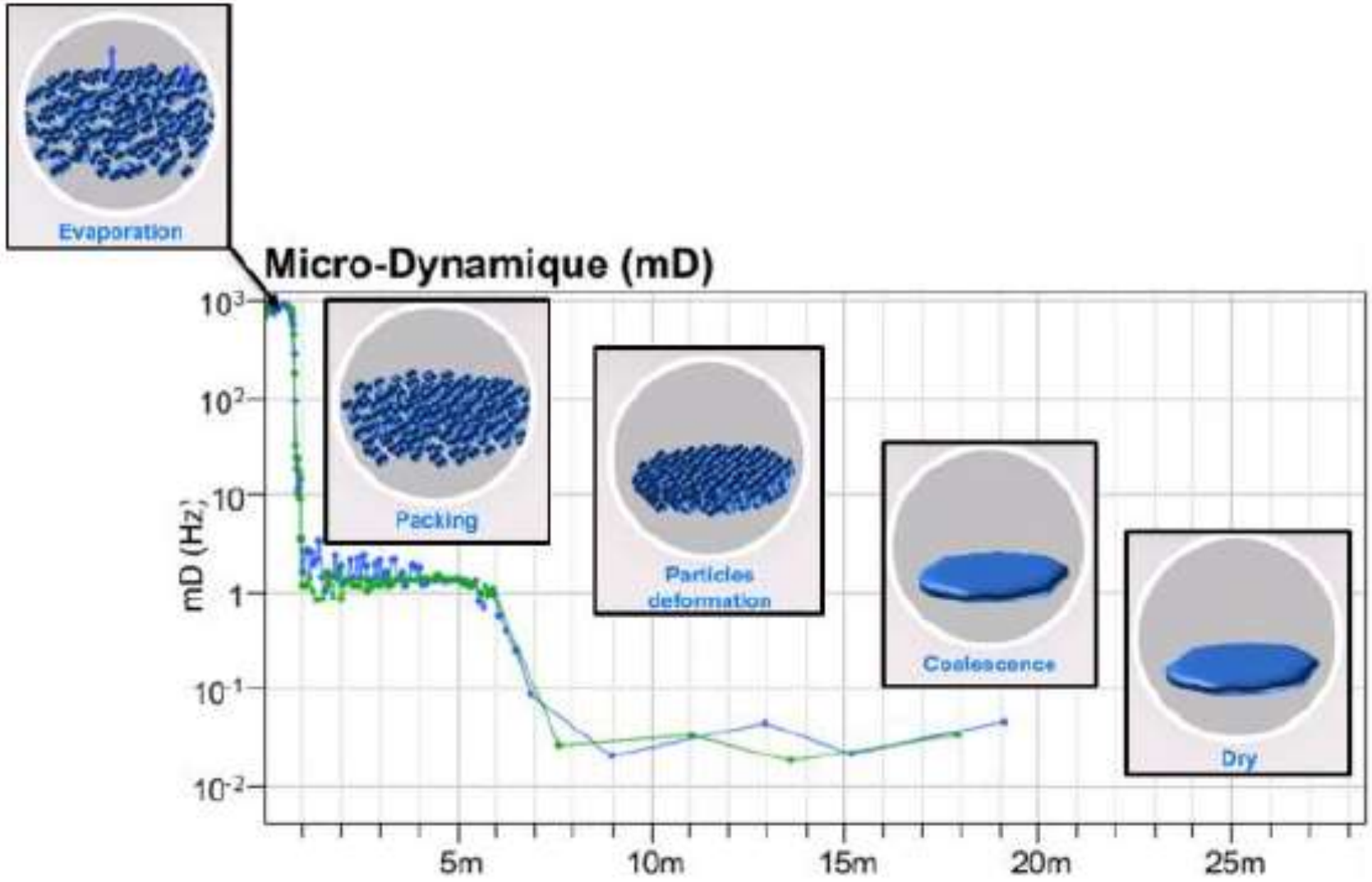


Figure 3: Exemple of Microdynamics in function of time for water-based paints including dyring mechanism determination

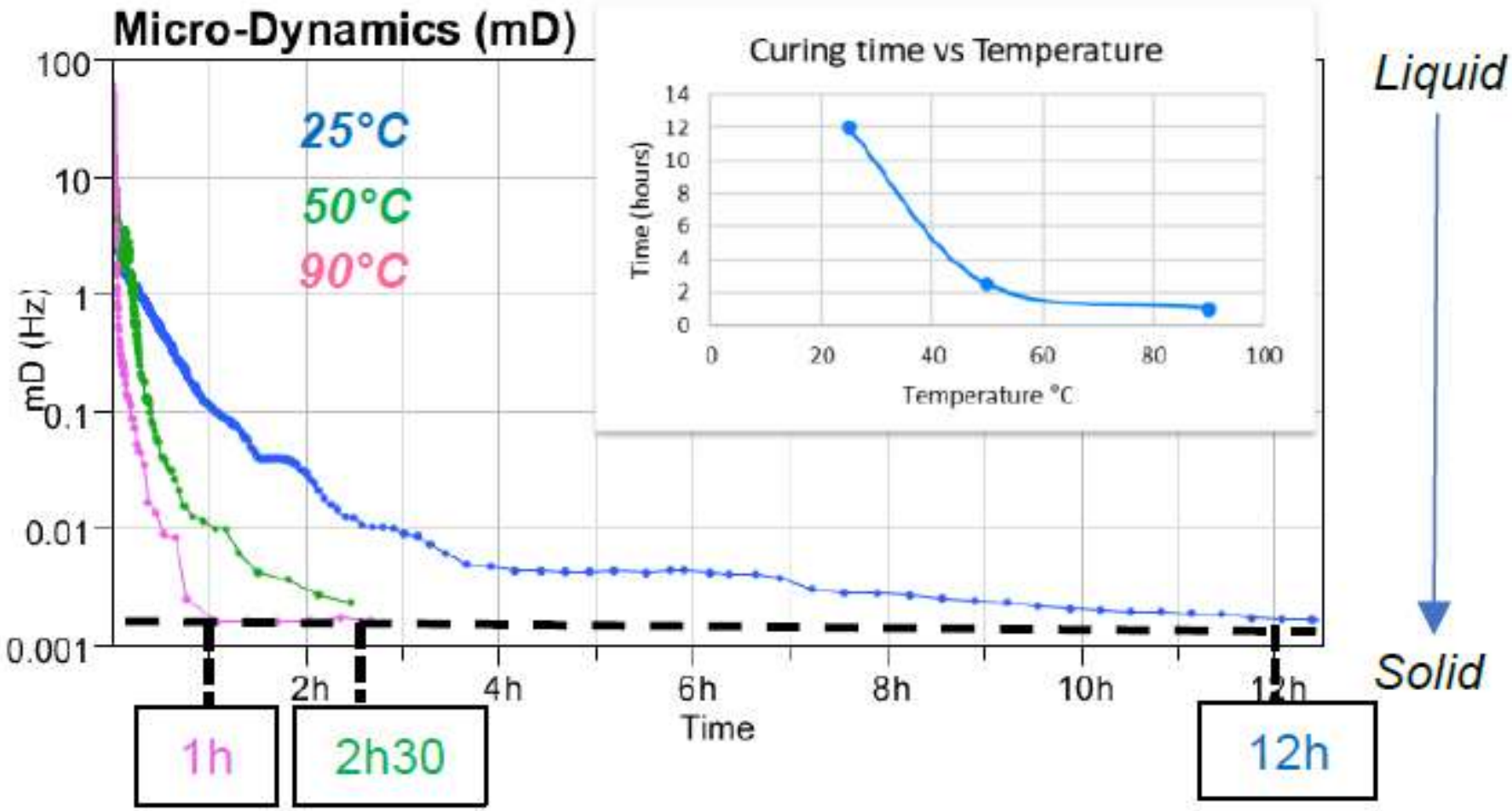


Figure 4: Microdynamics in function of time for epoxy adhesive for 25°C, 50°C and 90°C

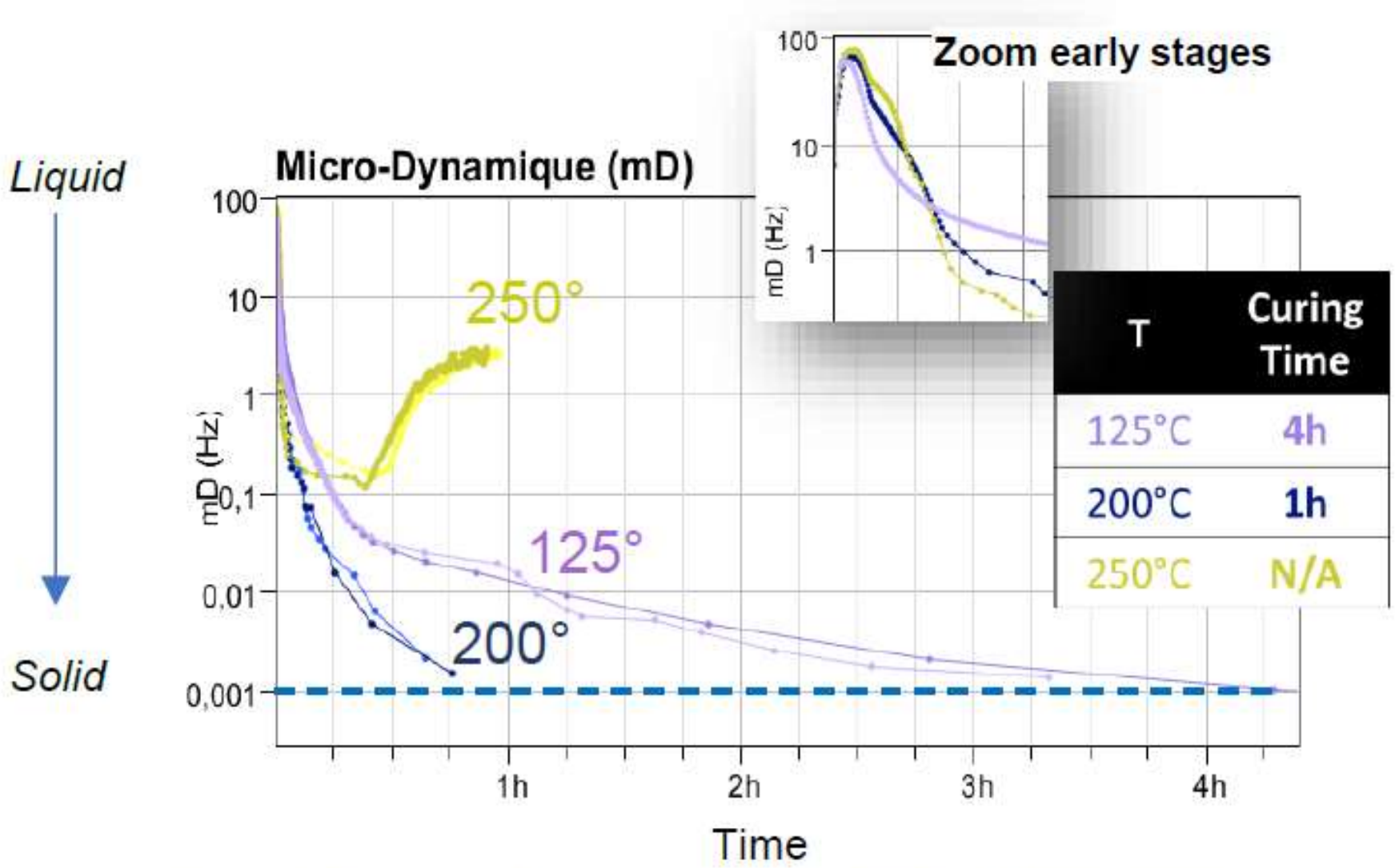


Figure 5: Power coating drying kinetics (mD) at 125°C, 200°C and 250°C

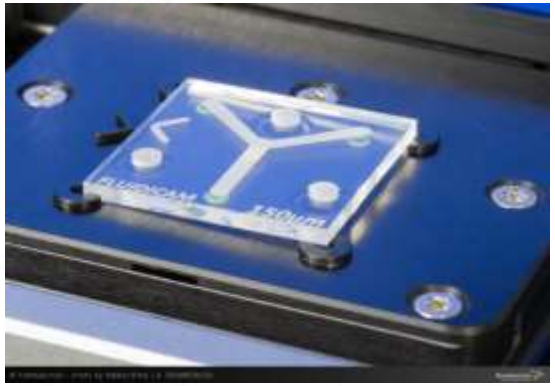
TURBISCAN
STABILITY & SIZE

RHEOLASER
MICRORHEOLOGY

FLUIDICAM
RHEOLOGY ON CHIP

Flow Rheomether based on Microfluidics

- *High shear: 100 to +$10^5 s^{-1}$*
- *Very sensitive even at low viscosity*
- *Small sample volume (< 500 µl)*
- *Fast temperature screening*



COMPANY PROFILE

FLUIDICAM Rheo

3 key arguments

Very Precise
Very Fast
Wide shear range

3 Advantages vs competition

Direct calibration
No sensors inside chip
Dirty & clean samples

3 Main Applications

High shear for Coating, Pharma
Low viscosity for Ink, Pharma & Beverages
Versatile for Cosmetic, Petroleum


AstraZeneca
bp
Unilever
kraft foods
make today delicious
BASF
The Chemical Company
中国石油化工股份有限公司
CHINA PETROLEUM & CHEMICAL CORPORATION
Rhodia
RICOH
NEC
Pfizer
GE
gsk
GlaxoSmithKline
LAFARGE
Wahaha
xerox
kao
P&G
3M
L'ORÉAL
PARIS
Nestlé
LG
Canon
DOW
Coca-Cola
MERCK
EXXON
Colgate
Dior
中国石油天然气股份有限公司
PetroChina Company Limited
TOSHIBA
TOTAL
SAMSUNG
FUJIFILM
Johnson&Johnson
BR
PETROBRAS
illy
eni
TDK
DANONE
DANISCO
PDVSA
NOVARTIS
SEIKO
Lilly
WELLA
AkzoNobel
Tomorrow's Answers Today
sanofi aventis
L'essentiel c'est la santé
MITSUBISHI
CHEMICAL
KONICA MINOLTA
Knorr
REPSOL
Cargill
CHANEL
COLAS
DAEWOO
ELECTRONICS
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