MAKING « LIGHT » WORK OF COSMETICS TESTING

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Smart scientific analysis

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STABILITY & SIZE
MICRORHEOLOGY
RHEOLOGY ON CHIP

PHYSICAL STABILITY
Turbiscan®

STATIC MULTIPLE LIGHT SCATTERING

TURBISCAN®

Analyses migration destabilization phenomena

AND

Size variation on samples with particle size from 10 nm to 1 mm at concentrations from 10^{-4} % to 95 % v / v

Analyze the sample AS IT IS!

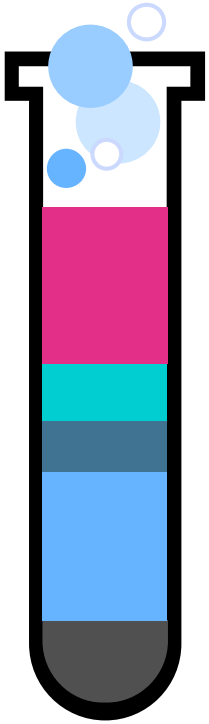
No dilution, no stress, no probes
Same conditions as visual tests
Only faster and more precise

PHYSCIAL STABILITY
Introduction

What is a liquid dispersion ?

A mixture

Multiple ingredients, non miscible phases (dispersed phase and continuous phase)



Different types

- Liquid / liquid = emulsion
- Solid / liquid = suspension
- Gas / liquid = foam

Stable / Unstable

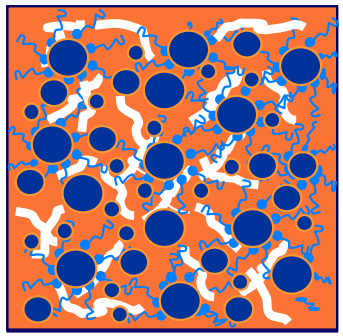
For user appreciation, the formulation must remain stable

PHYSCIAL STABILITY

Introduction

What is a liquid dispersion ?

- Complex products…

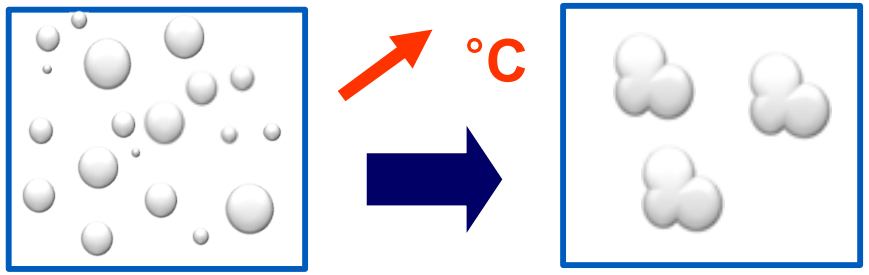


Particles or droplets
Additives (polymers …)
Surfactants

+ opacity !
+ viscosity !

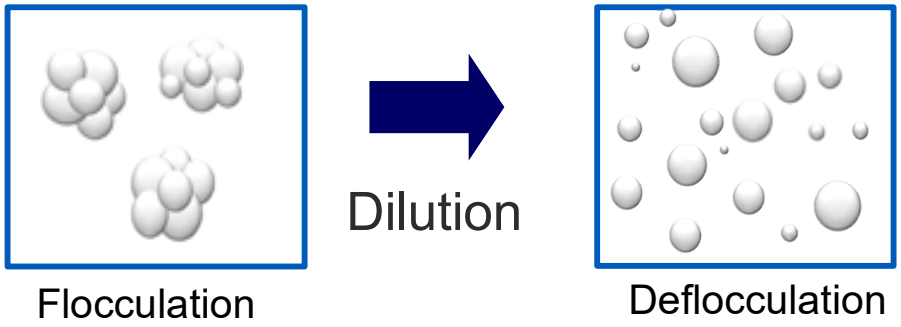
... That we need to understand in their native state

- Sensitive to temperature change



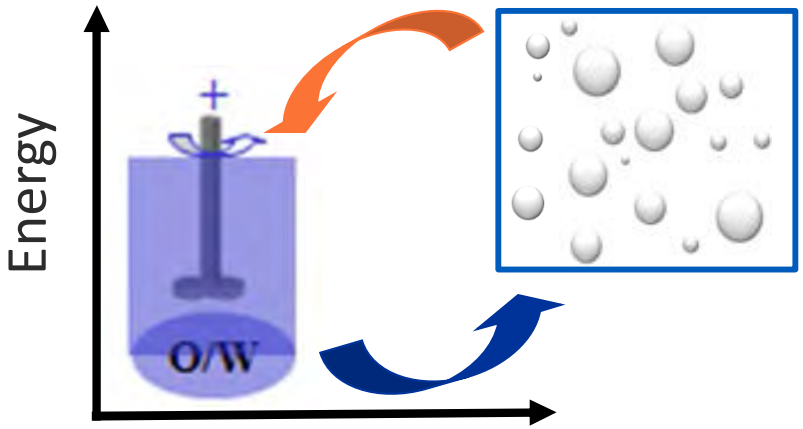
... And we need to analyze them in their actual storage conditions

- Sensitive to dilution



- Single particle analysis is necessary
- But native dispersion analysis is also relevant
  (without altering the particles interaction existing
  In the concentrated dispersions)

- Thermodynamically unstable



... Both manufacturing and breaking conditions
have to be monitored

PHYSICAL STABILITY
Definitions

- What is considered a Stable formulation ?

ideally

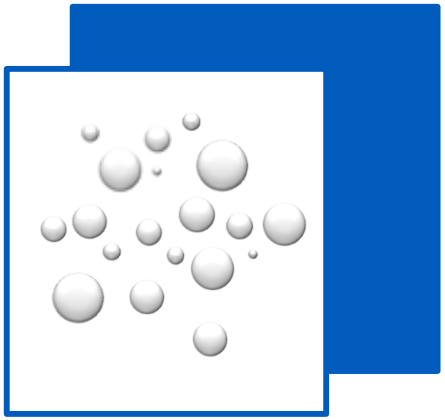
The system able to remain in the initial state:
particle size, homogeneity, sensorial properties, rheology, biology….

In practice, no such product exists

Every system <u>evolves</u>

Dispersed phase will always present in different states / sizes in the continuous phase

Initial state



Almost all dispersions are unstable under the effect of temperature
BUT
It is the kinetic stability that will determine whether the formulation is acceptable

PHYSICAL STABILITY
Definitions

- What is considered a Stable formulation ?

ideally

The system able to remain in the initial state:
particle size, homogeneity, sensorial properties, rheology, biology….

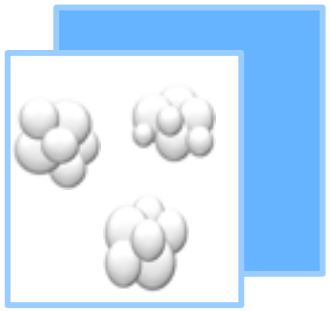
In practice, no such product exist

Every system evolves

Phyiscal unstability phenomena

Particle size increase

Flocculation

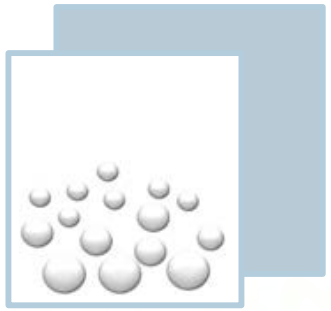


Coalescence

Migration phenomena

Creaming

Sedimentation



PHYSICAL STABILITY
Classical tests

⇒ Classical method for stability determination

BOTTLE TEST

- Direct Method
- Inexpensive
- Corresponds to real conditions (no stress…)

But What if the change is not easily visible ??

Before

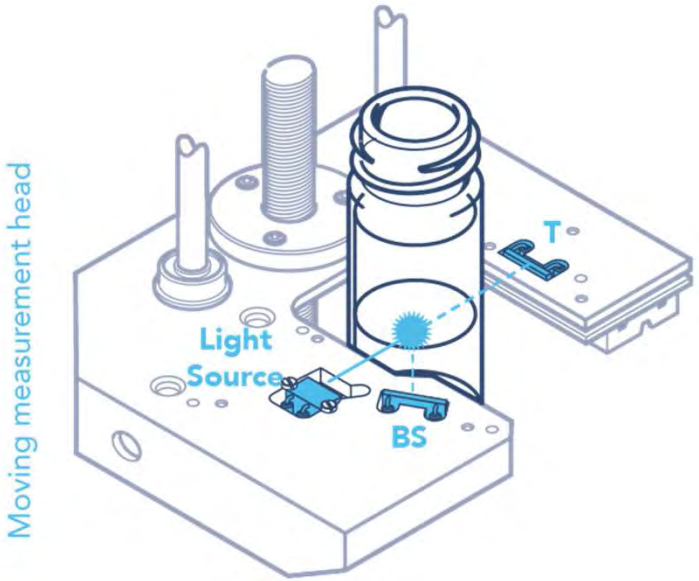
After

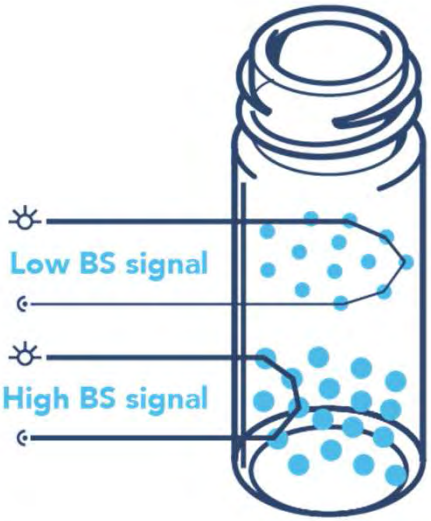
Limitations of the bottle test:

- Not sensitive -> may require several months and high temperatures
- Only sensitive to particle migration
- Not Objective : Depends on the Operator
- Doesn't quantify the phenomena

TURBISCAN TECHNOLOGY

How does it work?





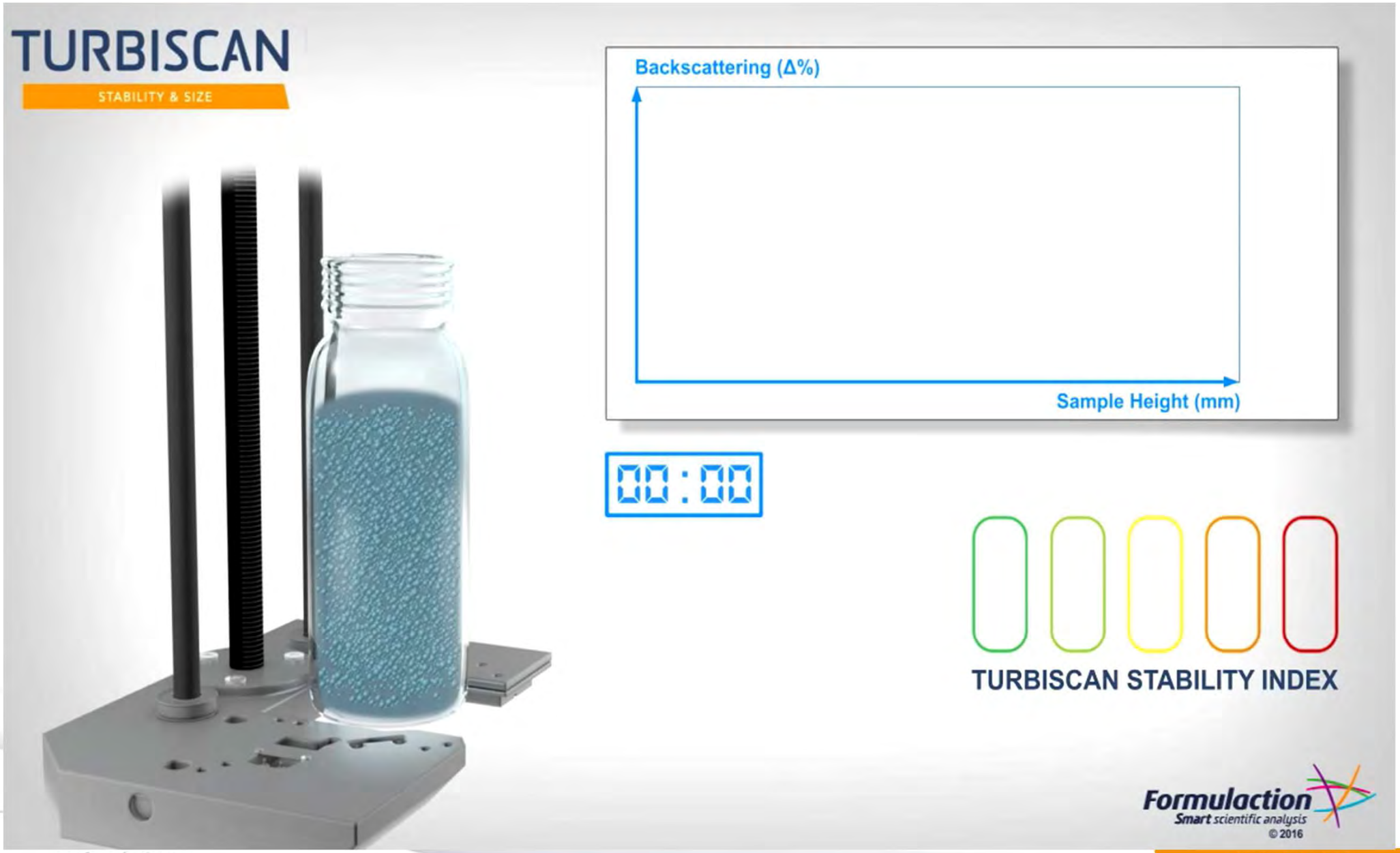
Backscattering and Transmission signals depend on :

d : Mean Particle size & Φ : Particle concentration

Scans are made **over the total sample height** and **periodically**

Variation in the sample ➡ Signal variation ➡ Monitoring of stability

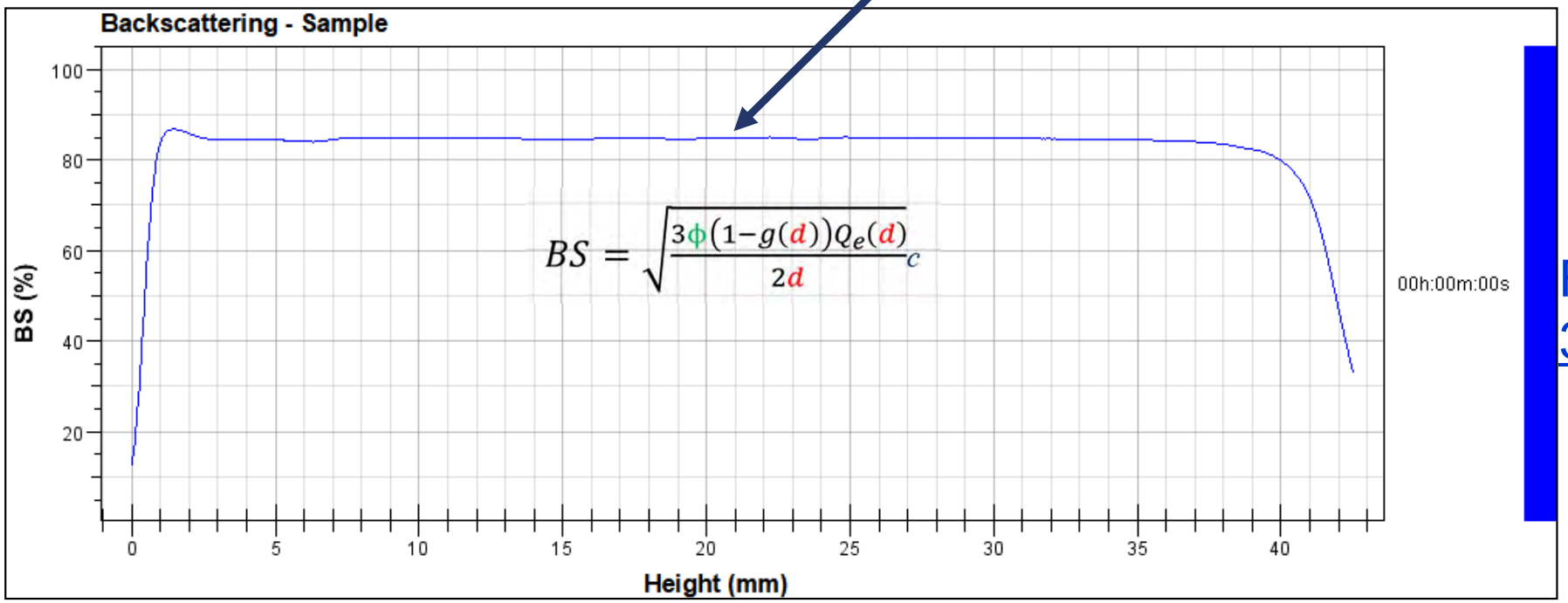
PHYSICAL STABILITY
Turbiscan®



TURBISCAN TECHNOLOGY

How does it work?

Particle size can be determined from the single curve

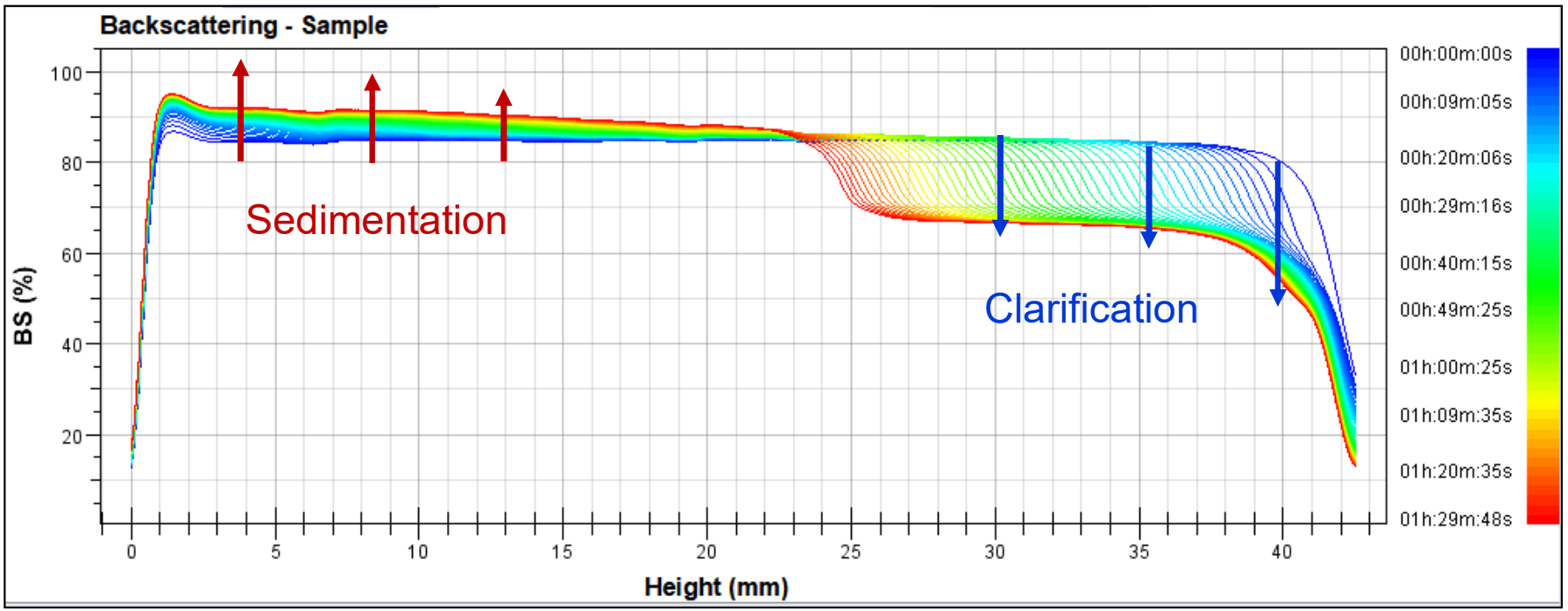


First scan
30 seconds

Single scan = **Size**

TURBISCAN TECHNOLOGY

How does it work?



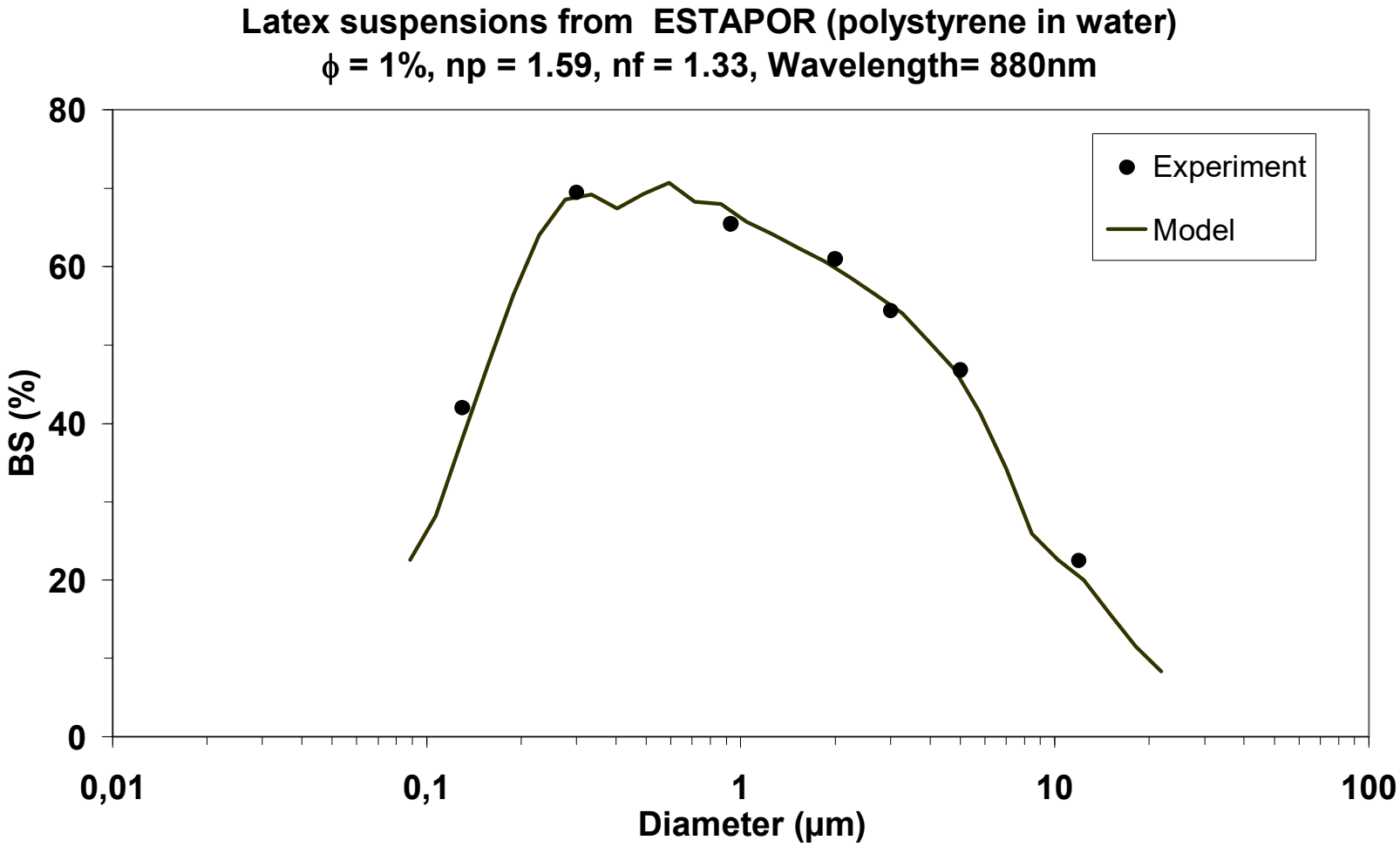
Multiple scans = time

Multiple scans, if variation = **DESTABILIZATION**

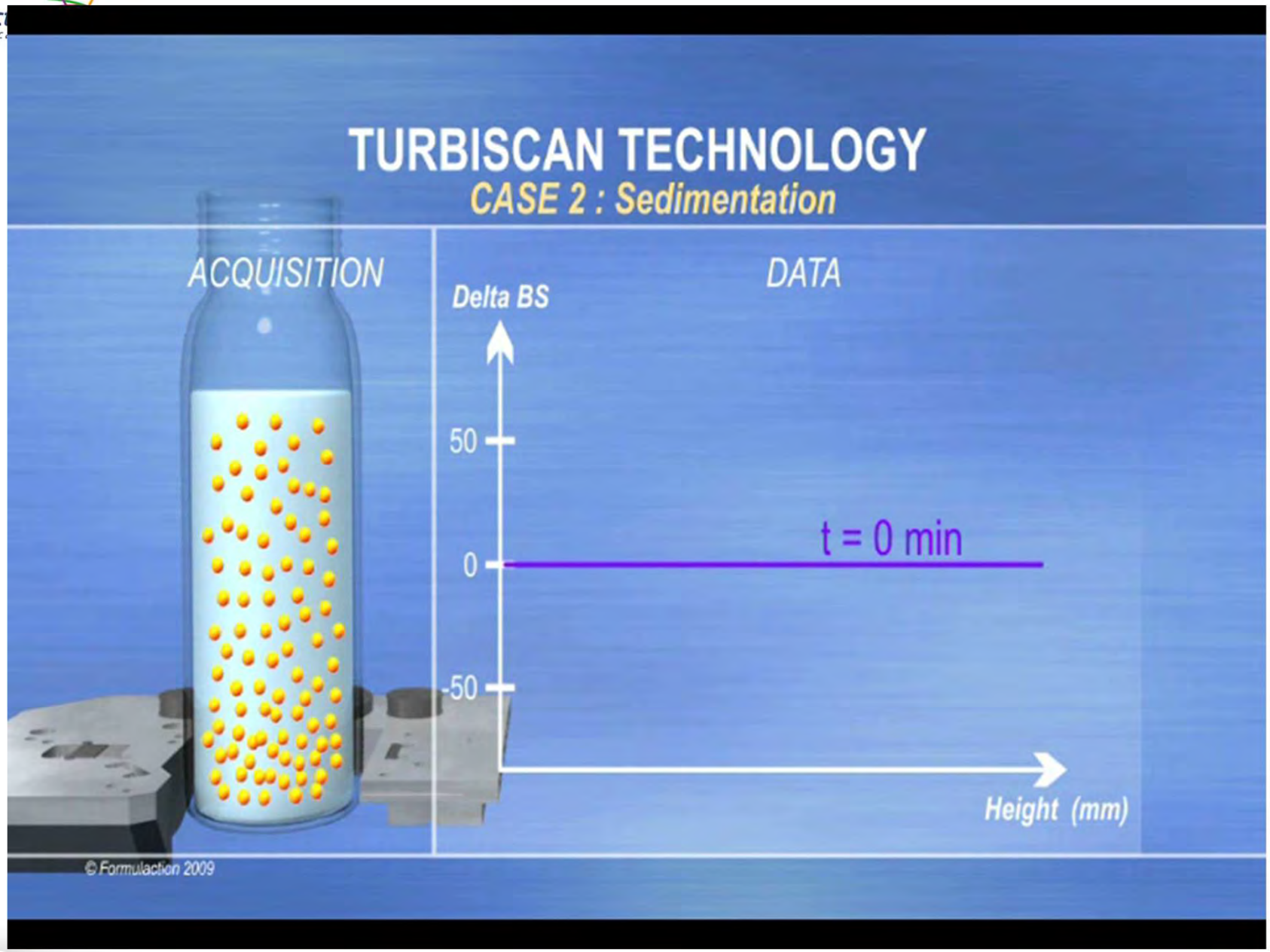
TURBISCAN TECHNOLOGY

How does it work?

Variation of Particle size



Size range : from 1nm to 1mm


TURBISCAN TECHNOLOGY
CASE 2 : Sedimentation
ACQUISITION
DATA
Delta BS
50
0
-50
t = 0 min
Height (mm)
© Formulaction 2009

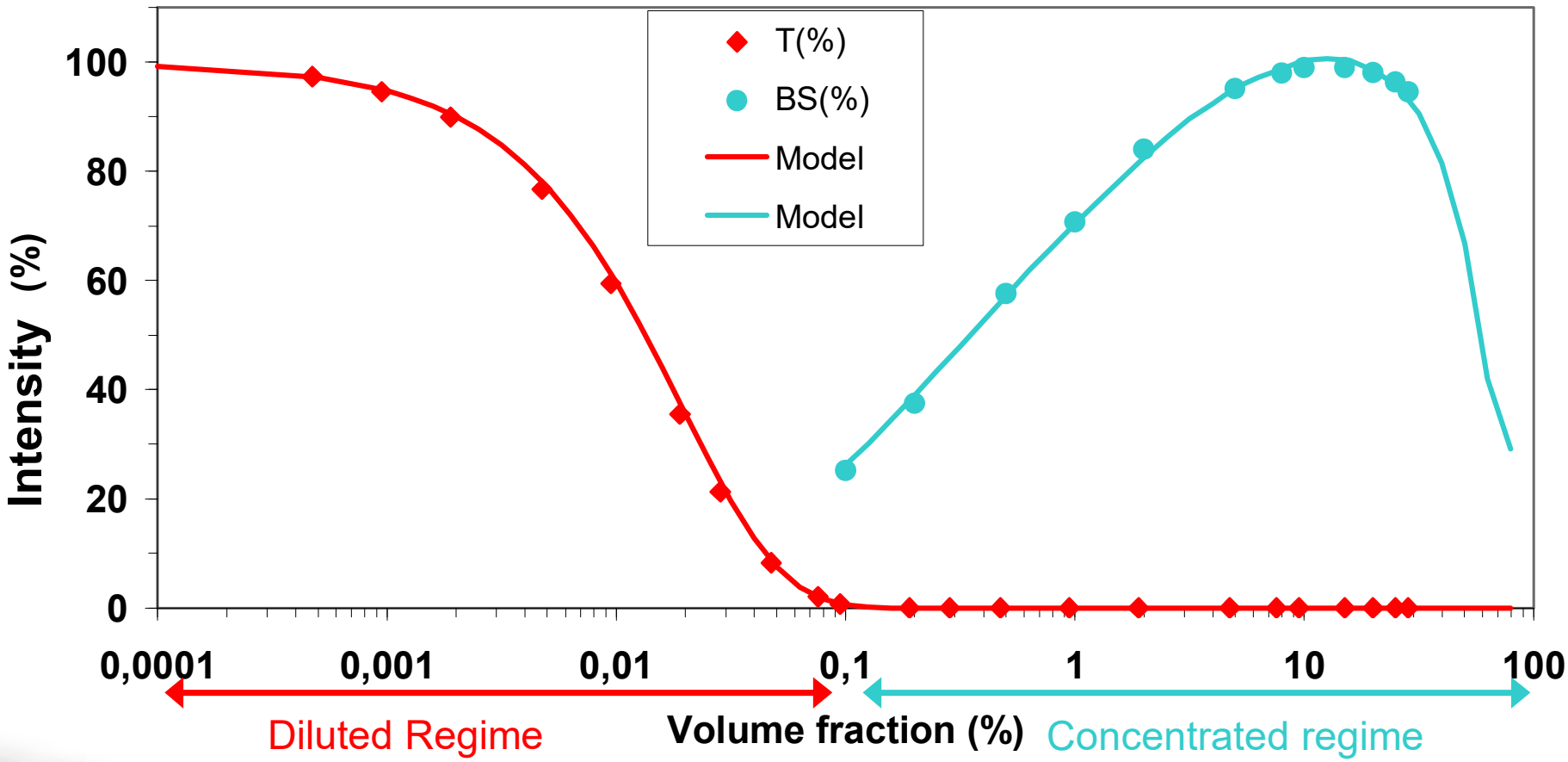
TURBISCAN TECHNOLOGY

How does it work?

Variation of particle concentration

ESTAPOR latex suspension (polystyrene in water)

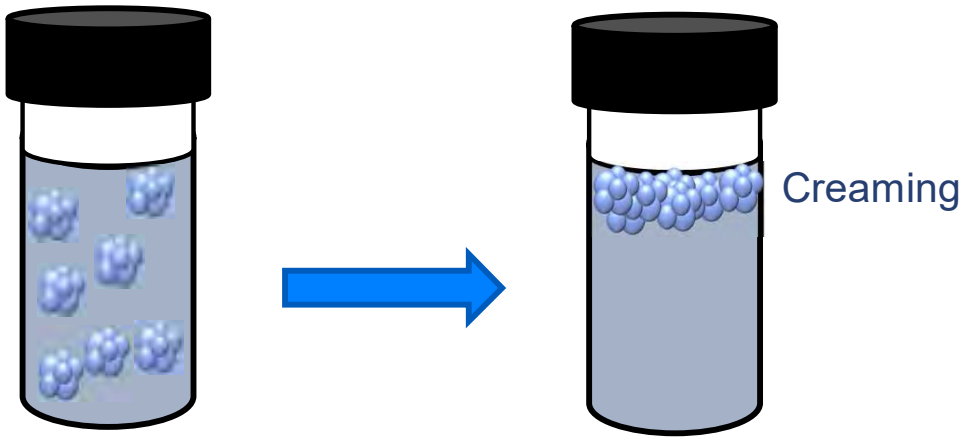
d = 0.3µm, np = 1.59, nf = 1.33, Wavelenght = 880nm



Concentration range : from 0.001 % to 95%

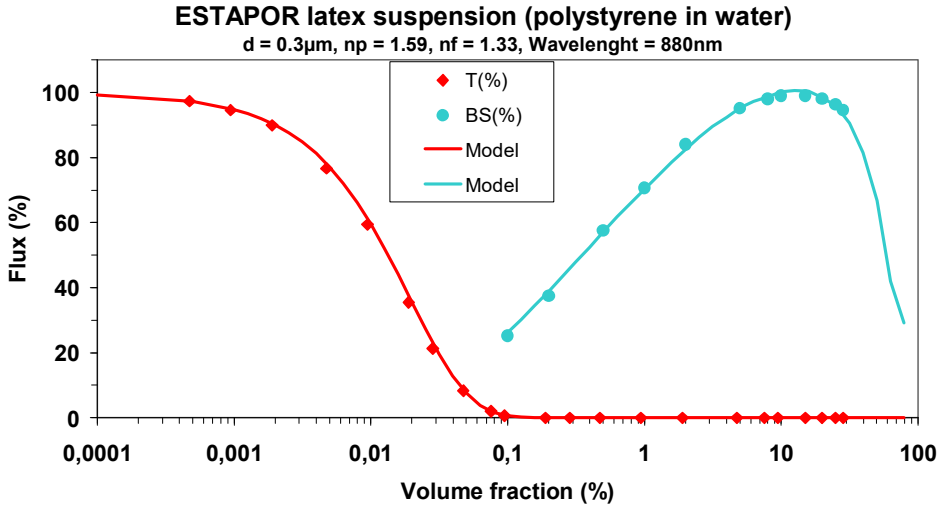
TURBISCAN TECHNOLOGY

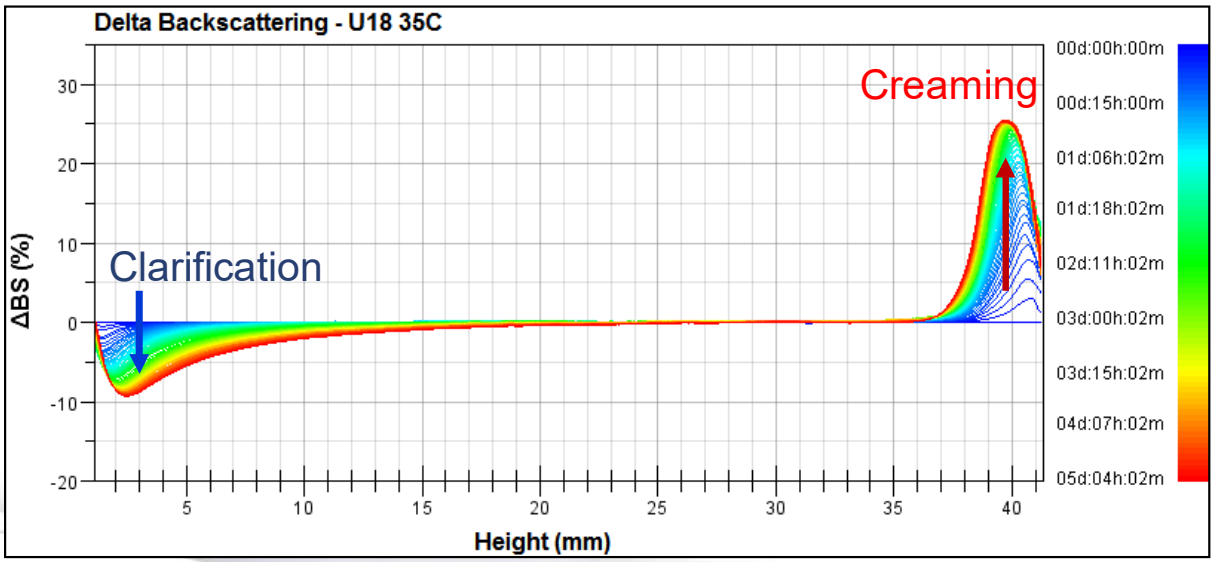
How does it work?

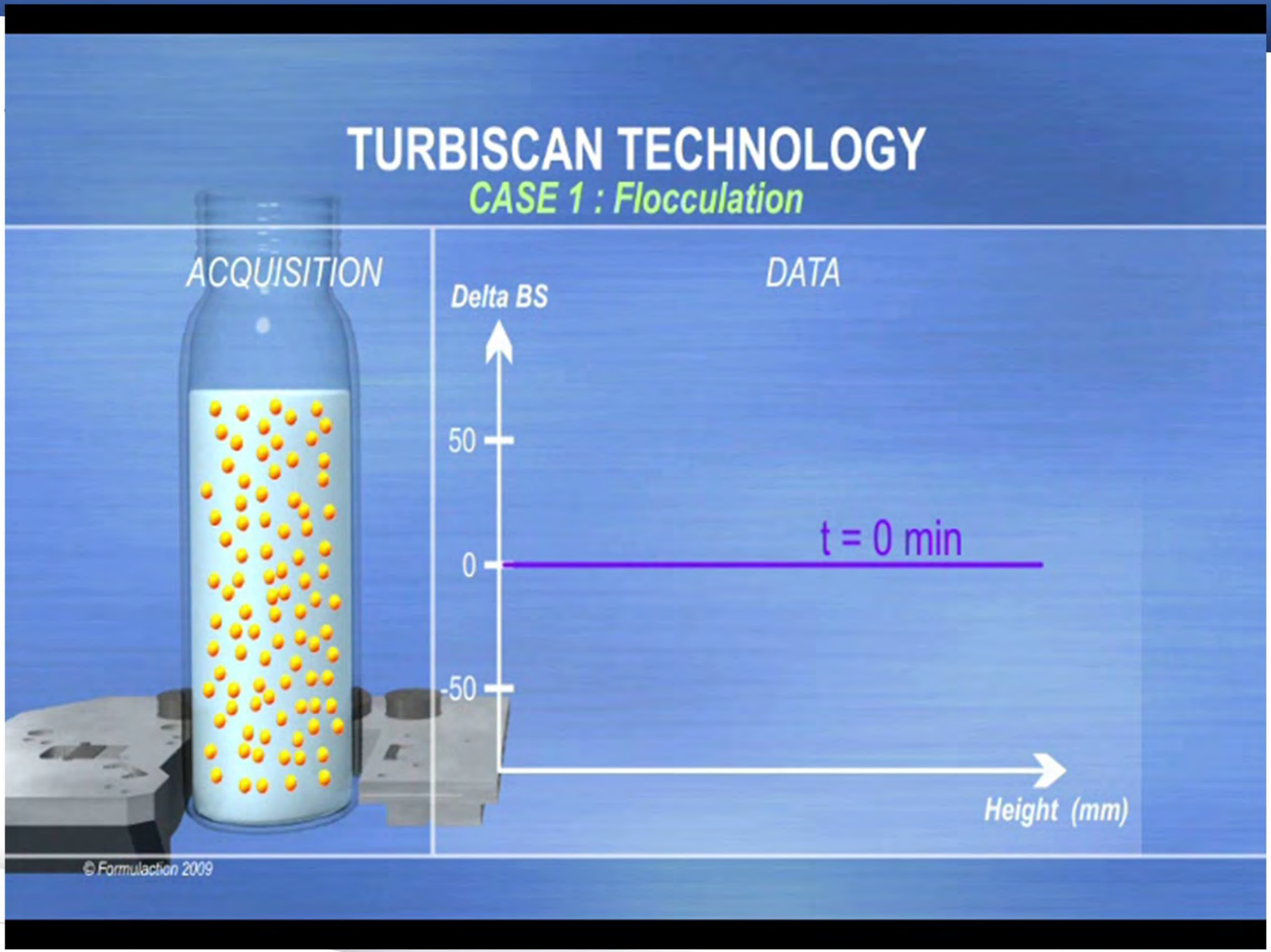


Opaque sample

Increase in BS at the top
Decrease in BS at the bottom



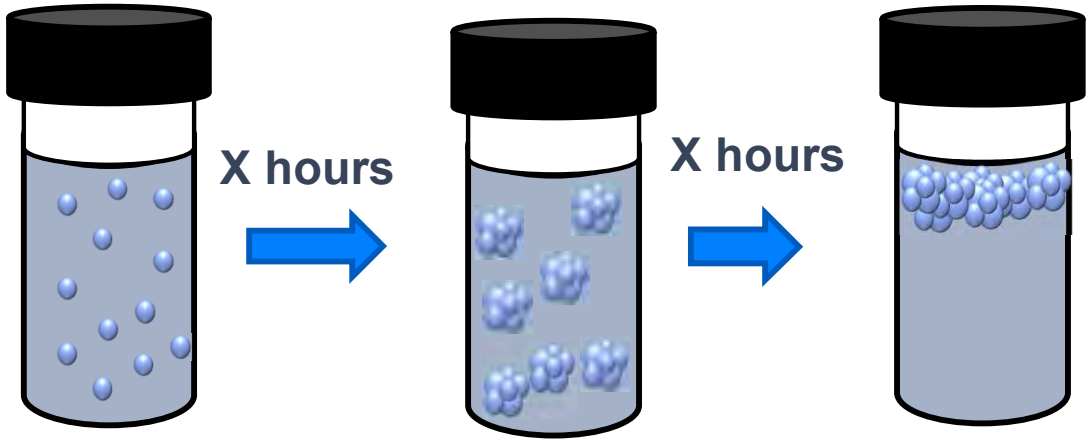


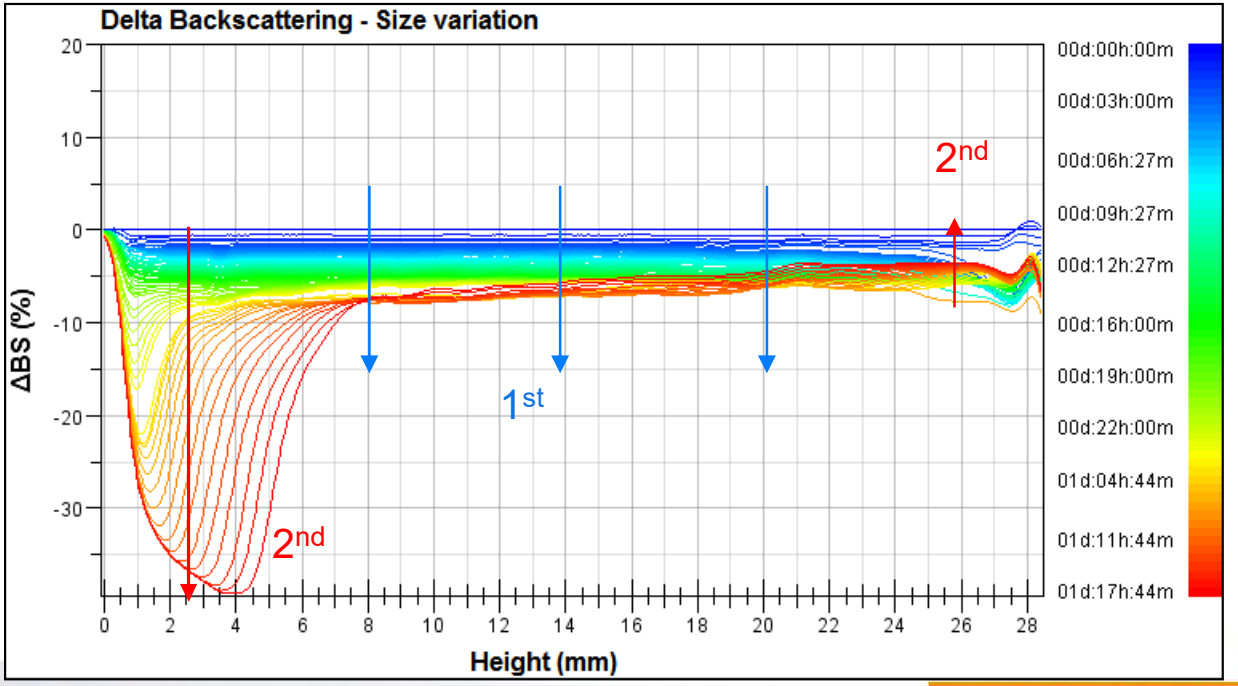

TURBISCAN TECHNOLOGY
CASE 1 : Flocculation
ACQUISITION
DATA
Delta BS
50
0
-50
t = 0 min
Height (mm)
© Formulaction 2009

TURBISCAN TECHNOLOGY

How does it work?

Combination of size increase and particle migration



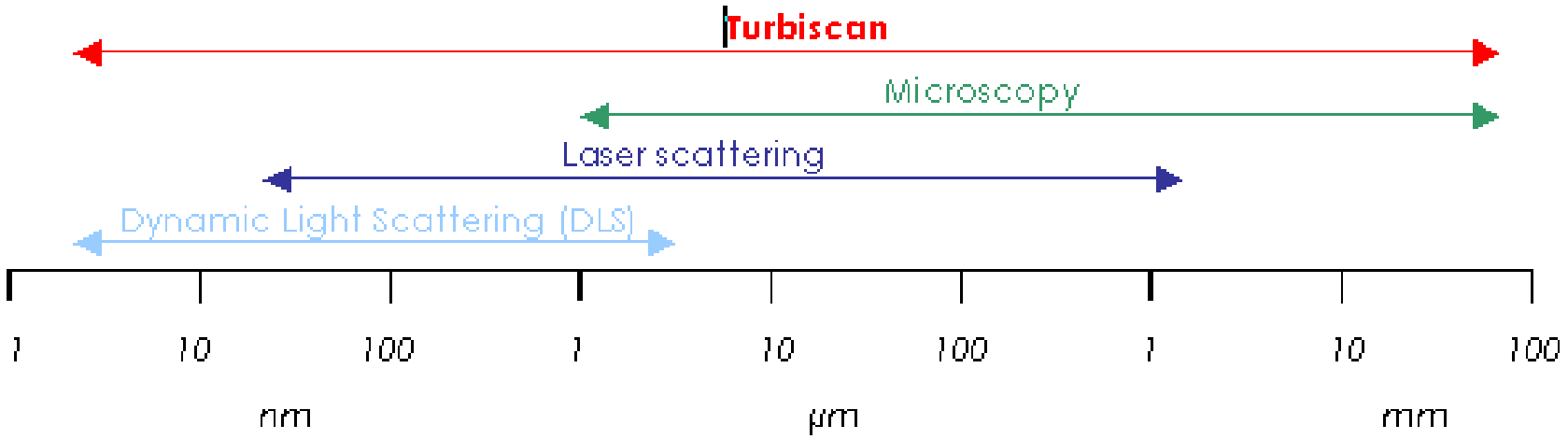


TURBISCAN TECHNOLOGY

Comparing to other techniques?

Average Size obtained by the turbisan not distribution

Size range : from 10nm to 1mm



Turbiscan:

Wavelength is 880nm

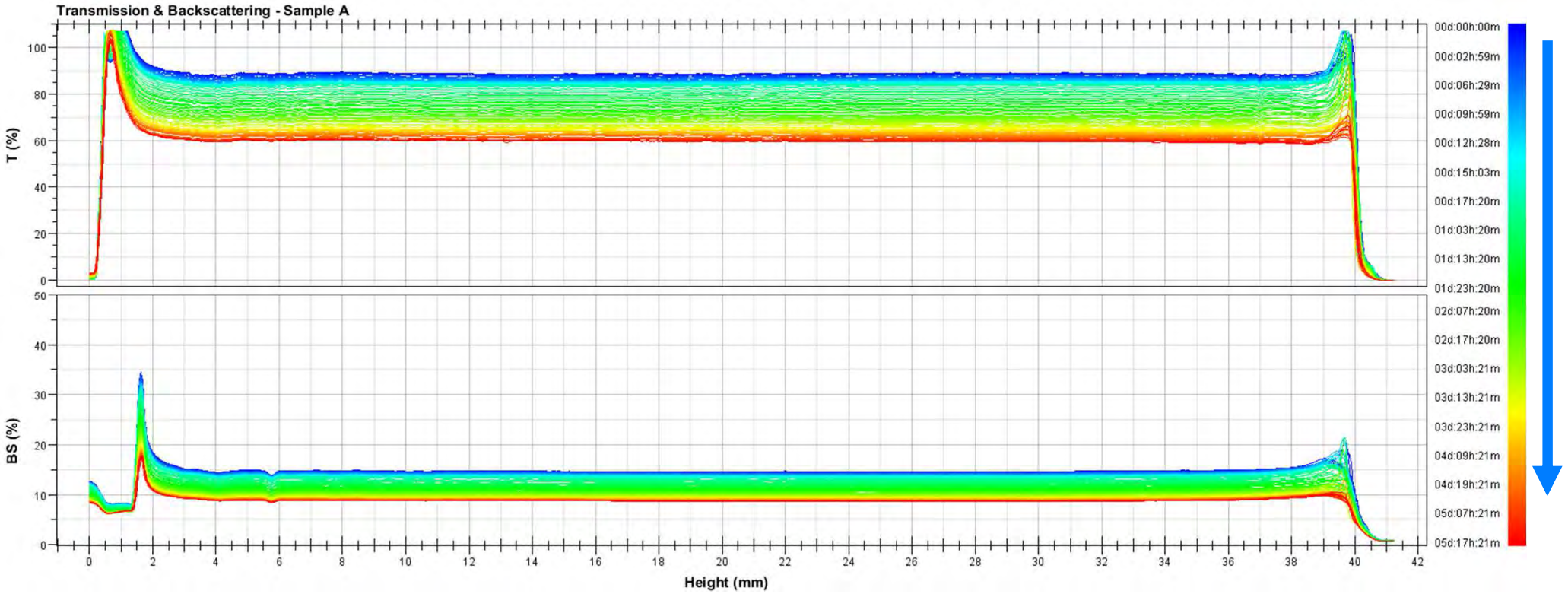
Multiple Light Scattering enough scattering events to get a signal

e.g 5-10nm carbon nano tubes has been measured

TURBISCAN TECHNOLOGY

Data interpretation

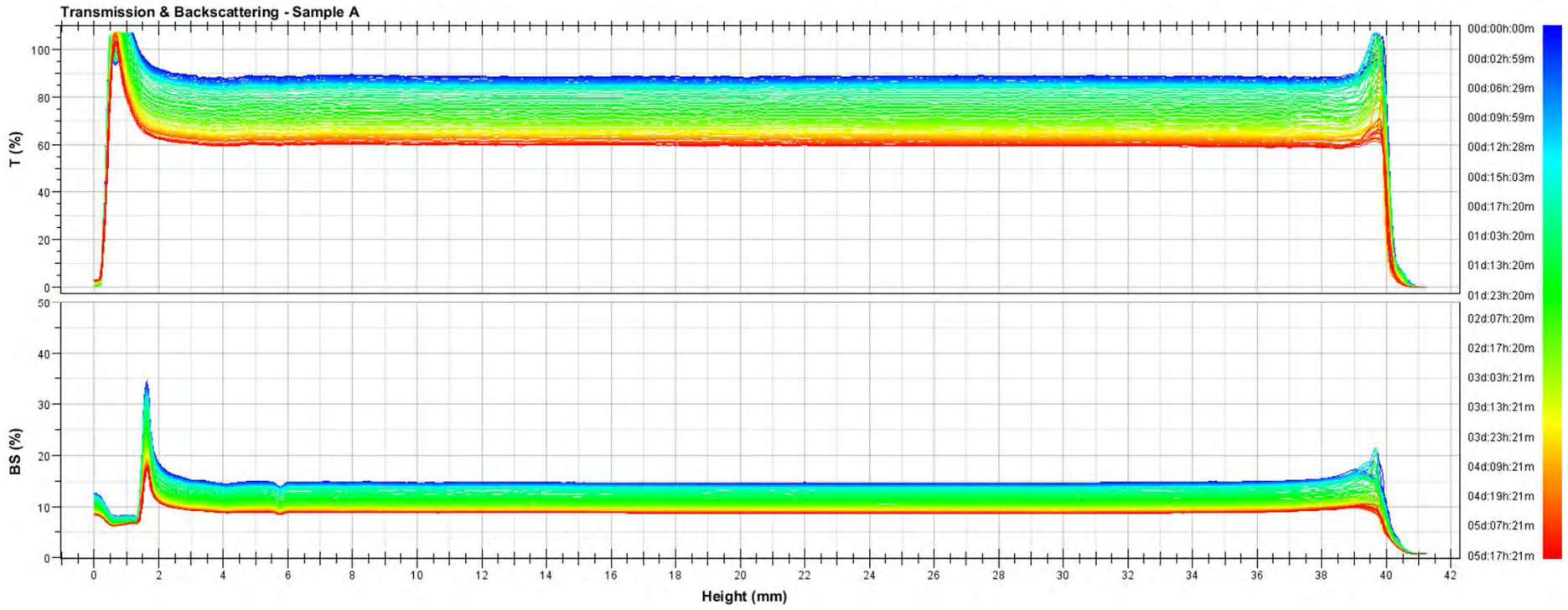
Blue to Red



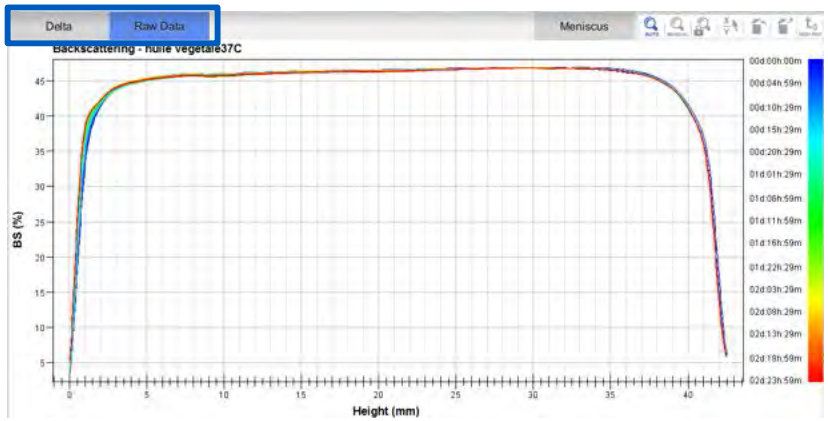
TURBISCAN TECHNOLOGY

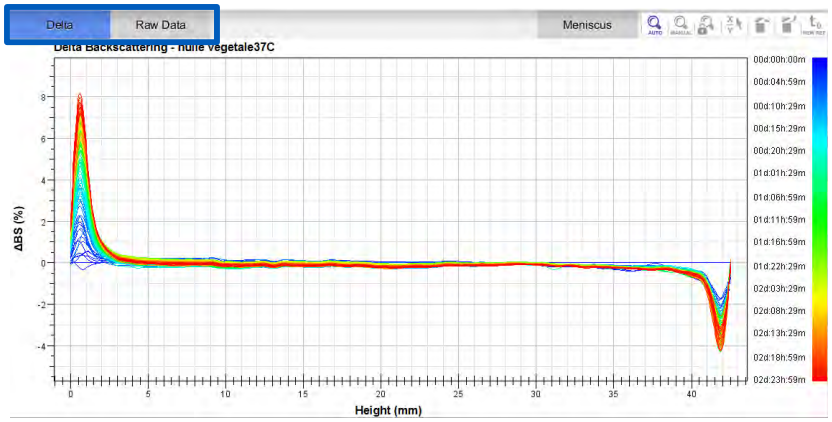
Data interpretation

Step 2 : Transmission or Backscattering ?



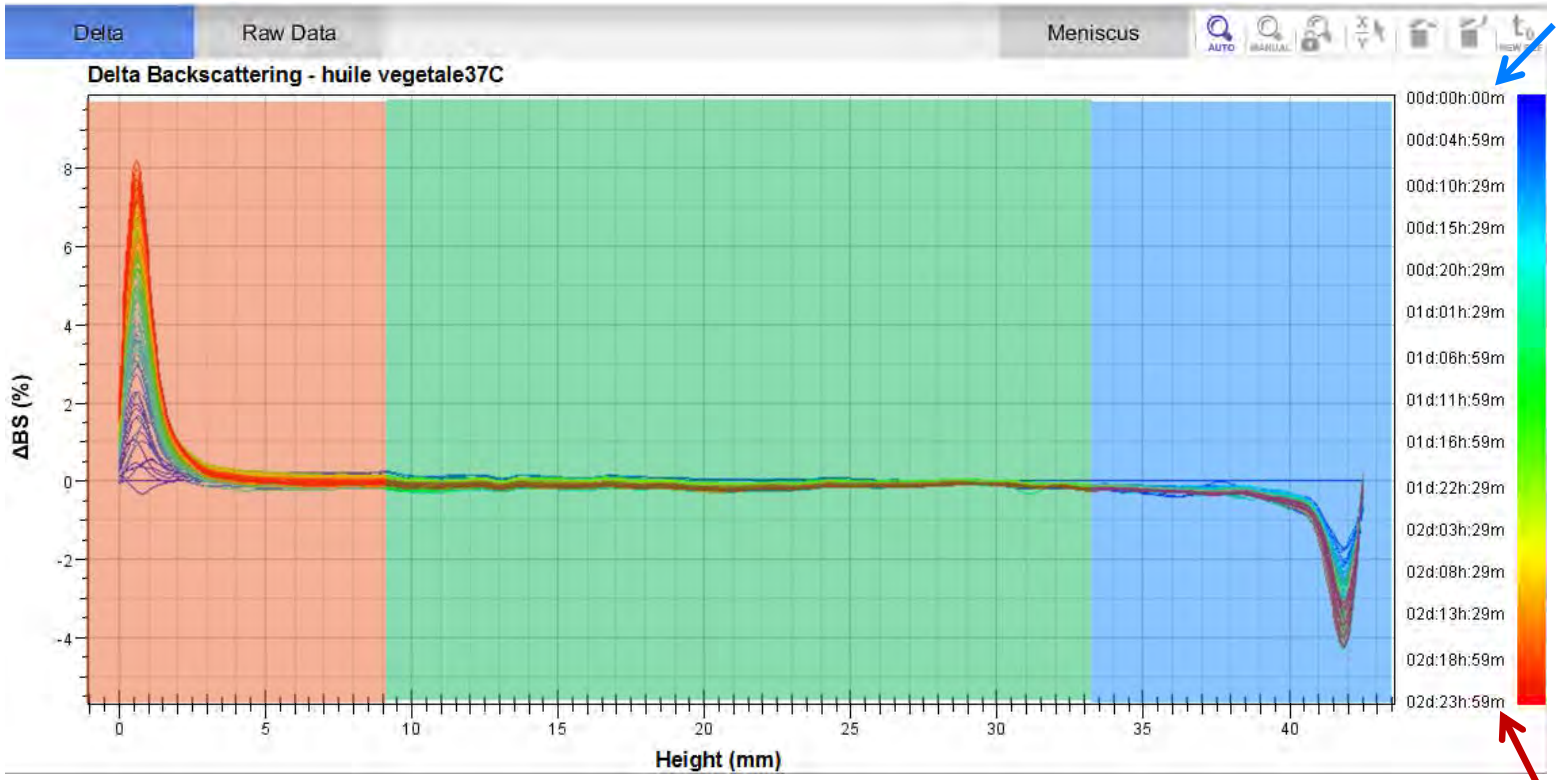
Step 3 : Put the profiles in DELTA Mode





Easier visualization of the destabilizations

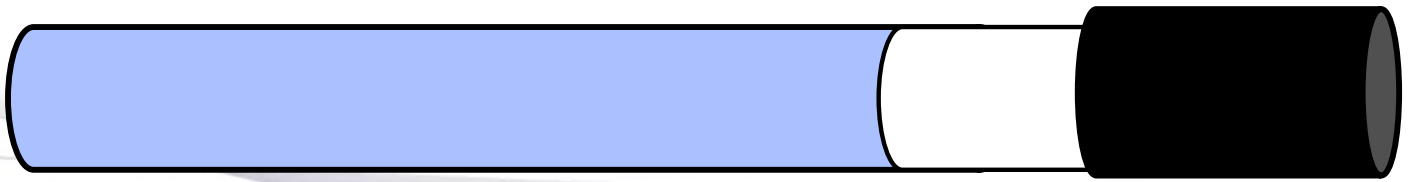
Step 4 : Identify the Instabilities



First scan in blue

Bottom Middle Top

Last in Red



Step 4 : Identify the Instabilities

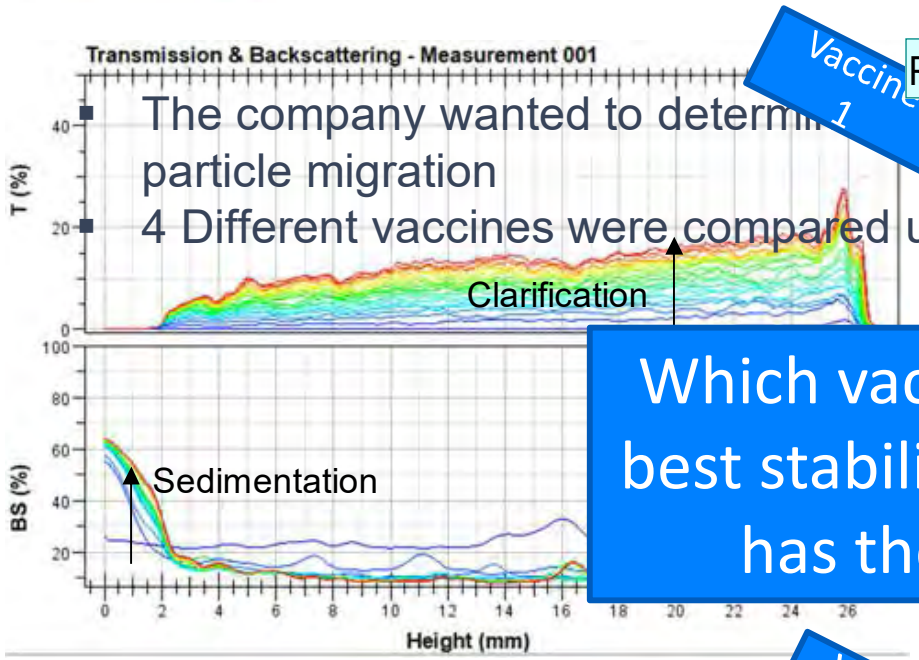
Delta BS	Bottom	Middle	Top	Instability phenomena
Case 1	↑	-	↓	Sedimentation
Case 2	↓	-	↑	Creaming
Case 3	↓ or ↑	↓ or ↑	↓ or ↑	Flocculation or coalescence

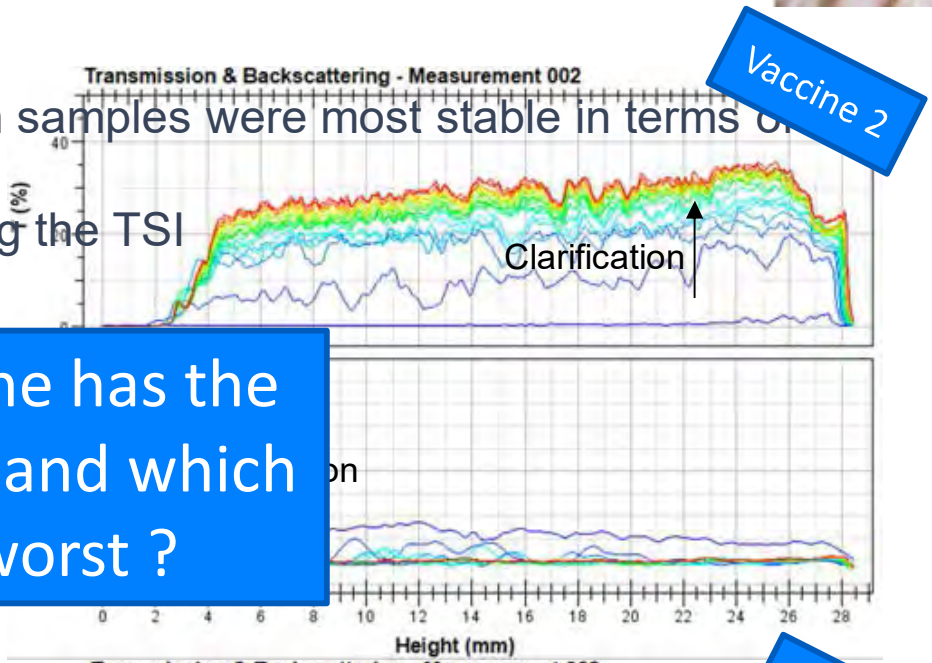
Turbiscan applications
PHARMACEUTICALS

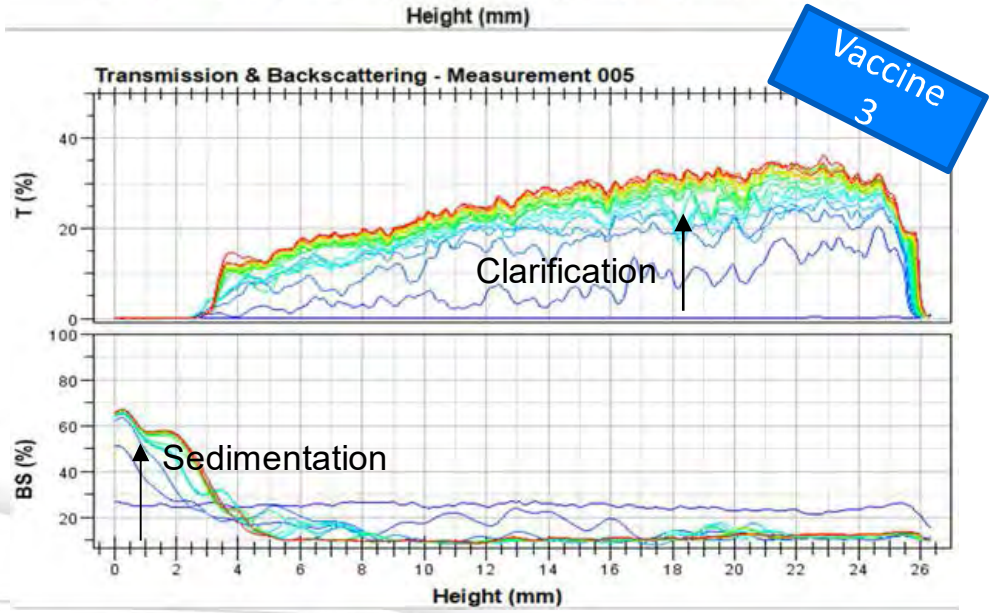
TSI Applications
Sedimentation in Vaccines

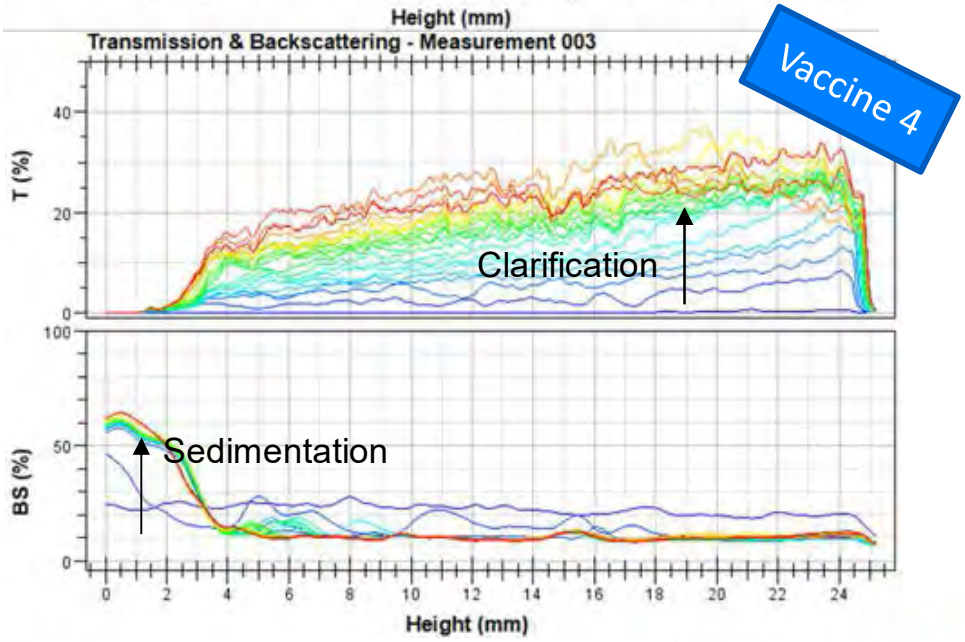
- The company wanted to determine which samples were most stable in terms of particle migration
- 4 Different vaccines were compared using the TSI

Which vaccine has the best stability and which has the worst ?





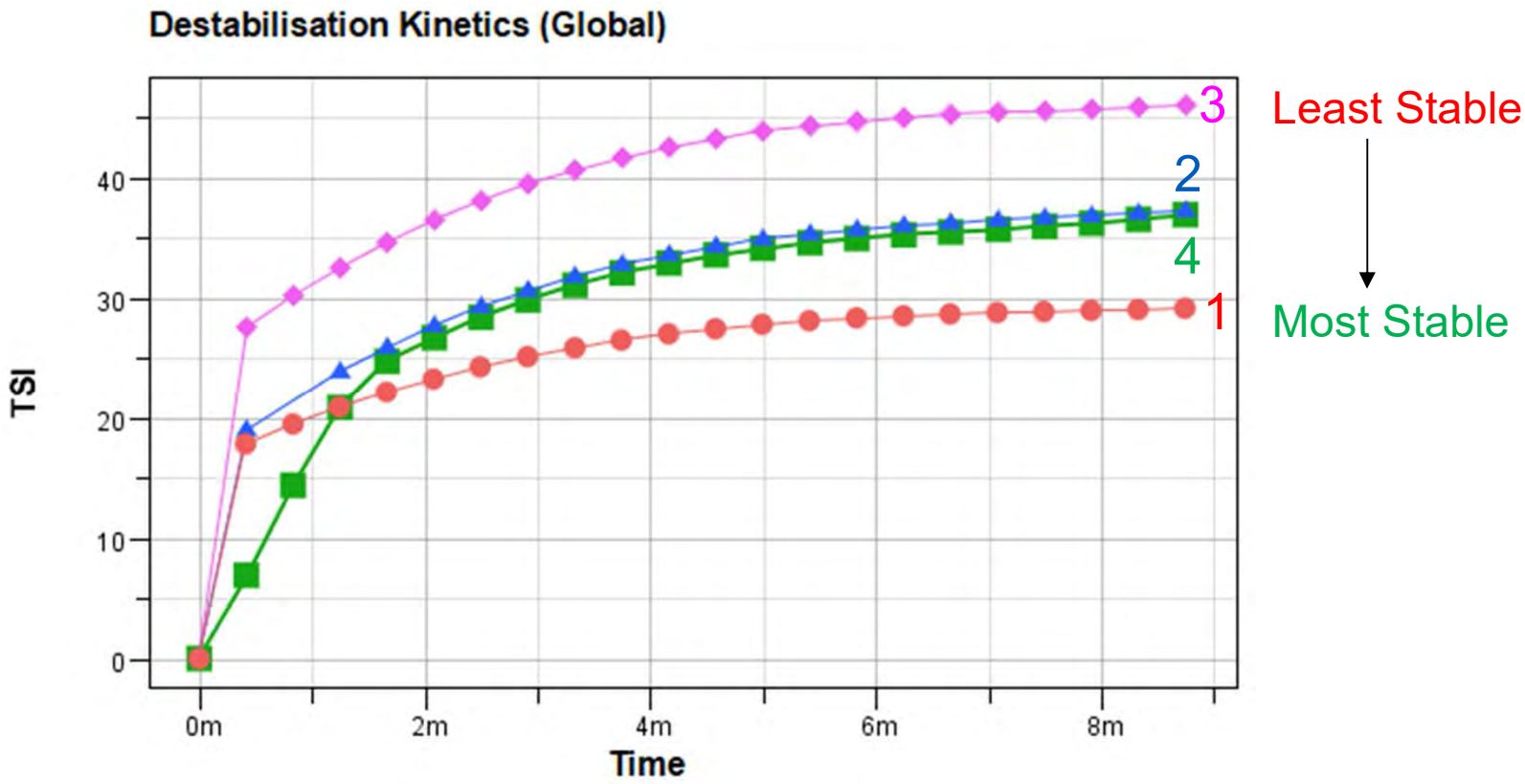




RF1 Change all graphs to delta!

Rasalhague Formulaction, 04/12/2017

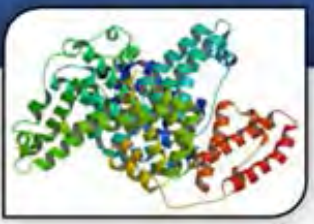
TSI Applications
Sedimentation in Vaccines



- After **8 minutes** of analysis they could see which samples had a better stability

Protein denaturation with temperature

BSA protein – Pharmaceutics field



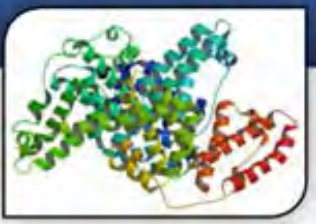
- **Problematic**: Temperature increase leads to proteins denaturation which consists in modifying interactions and going from transparent to opaque samples linked to size increase

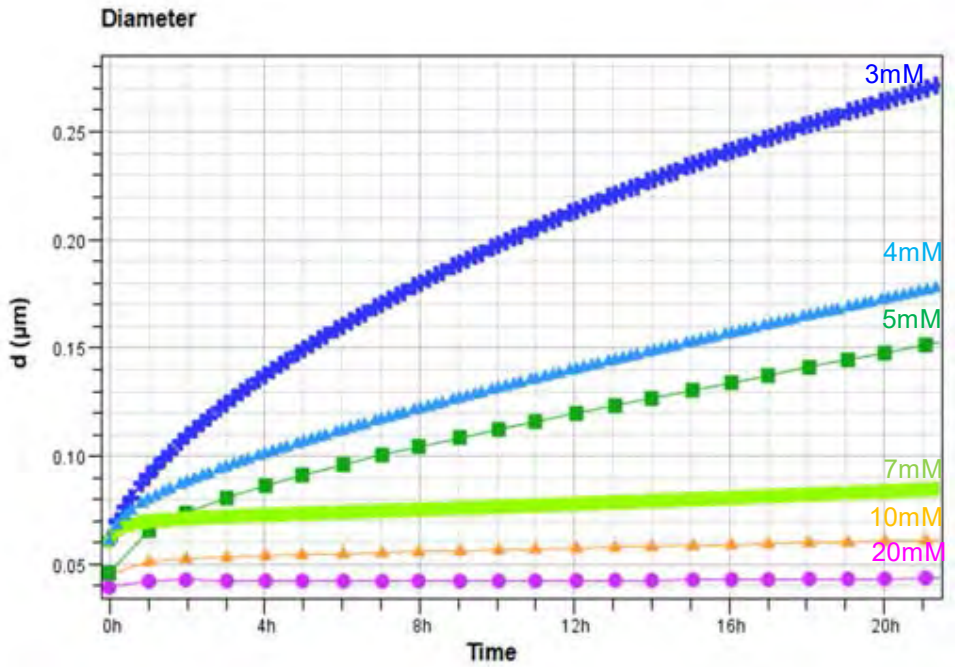
- **Solution**: Histidine, an amino-acid, is currently used to protect therapeutical protein against denaturation.

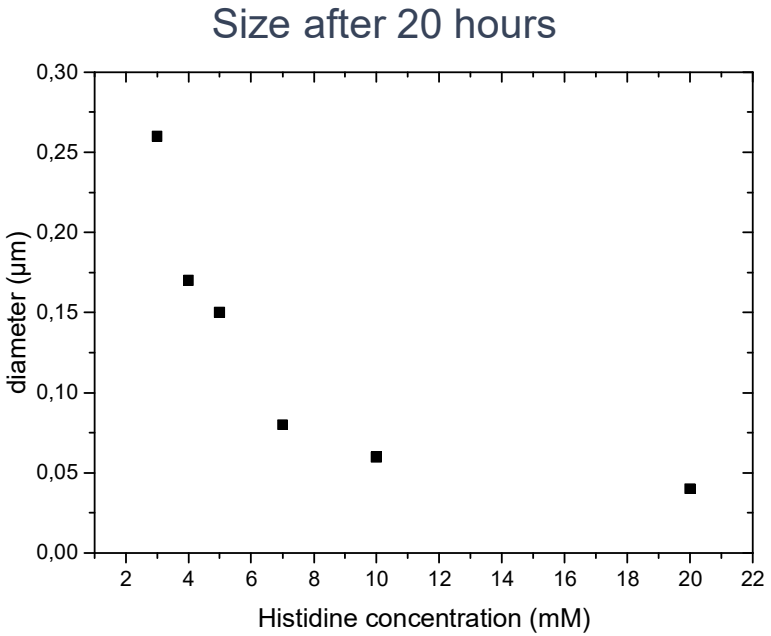
- **System**: 8 samples of BSA 10%wt with different amount of histidine (mM) were analysed at 60° C

Protein denaturation with temperature

BSA protein – Pharmaceutics field







⇒ Increasing histidine concentration enables to keep lower diameter and closer to native state without denaturation

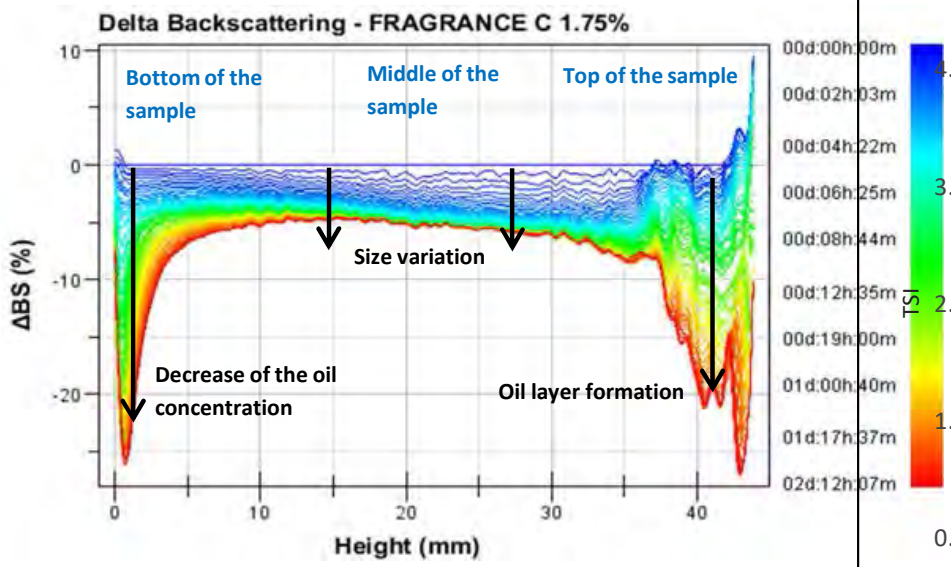
Turbiscan applications
HOME & PERSONAL CARE

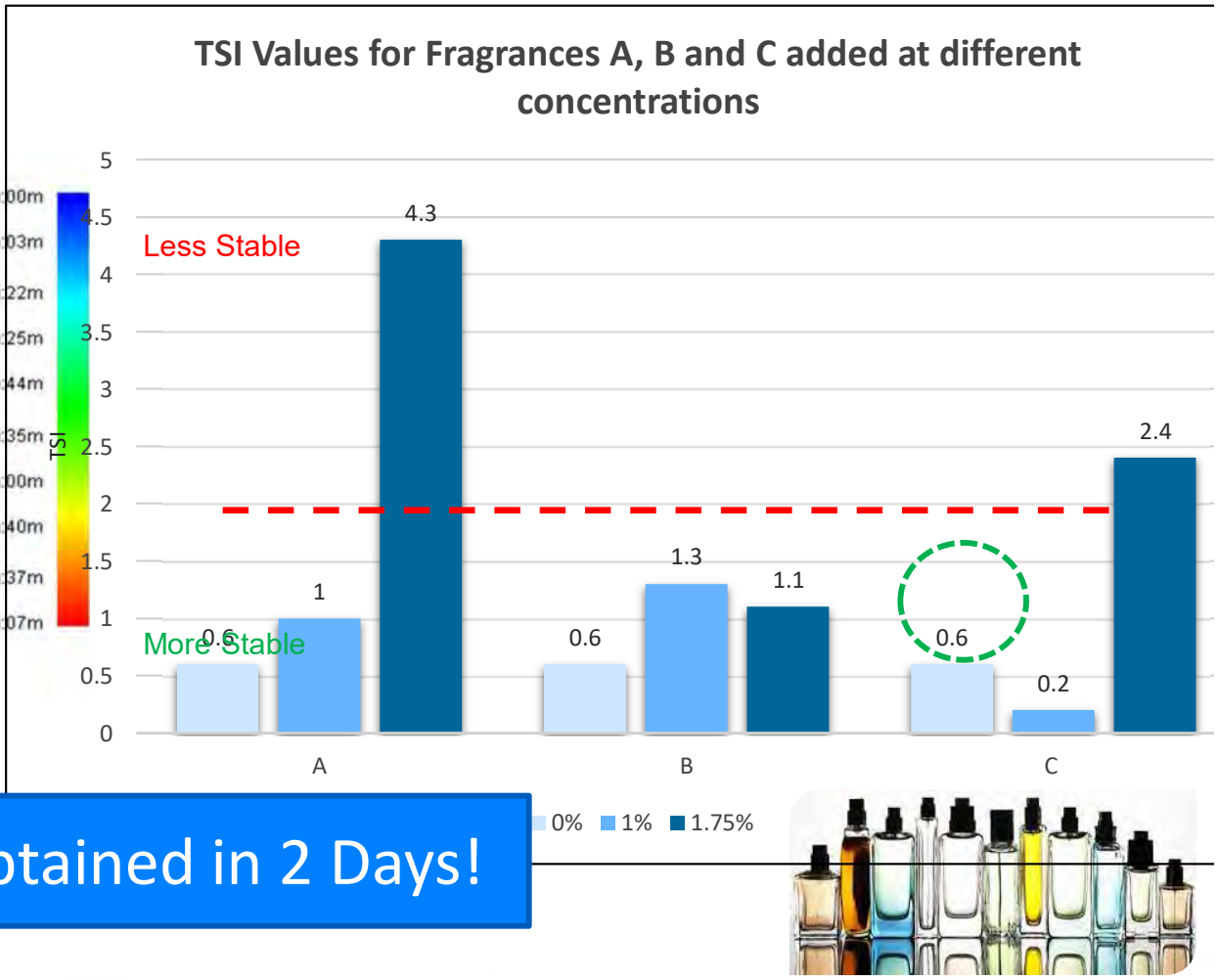
TSI Applications

Perfume stability with different fragrances

Givaudan

- Aim – Determine the stability of emulsions with added fragrances
- Fragrance A, B and C tested in the same emulsions, concentrations: 0%, 1% and 1.75%
- Usual test – 45 days at 45°C



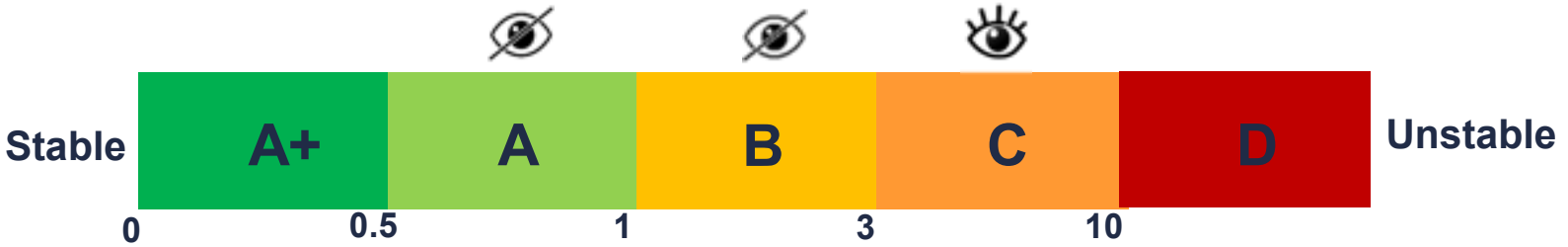


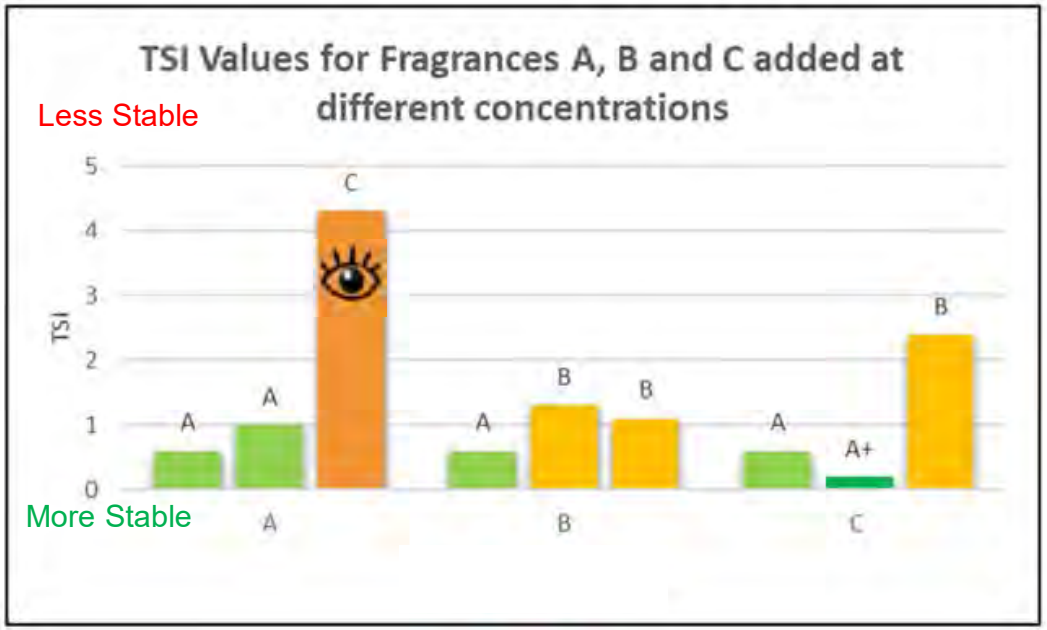
Results Obtained in 2 Days!

Turbiscan

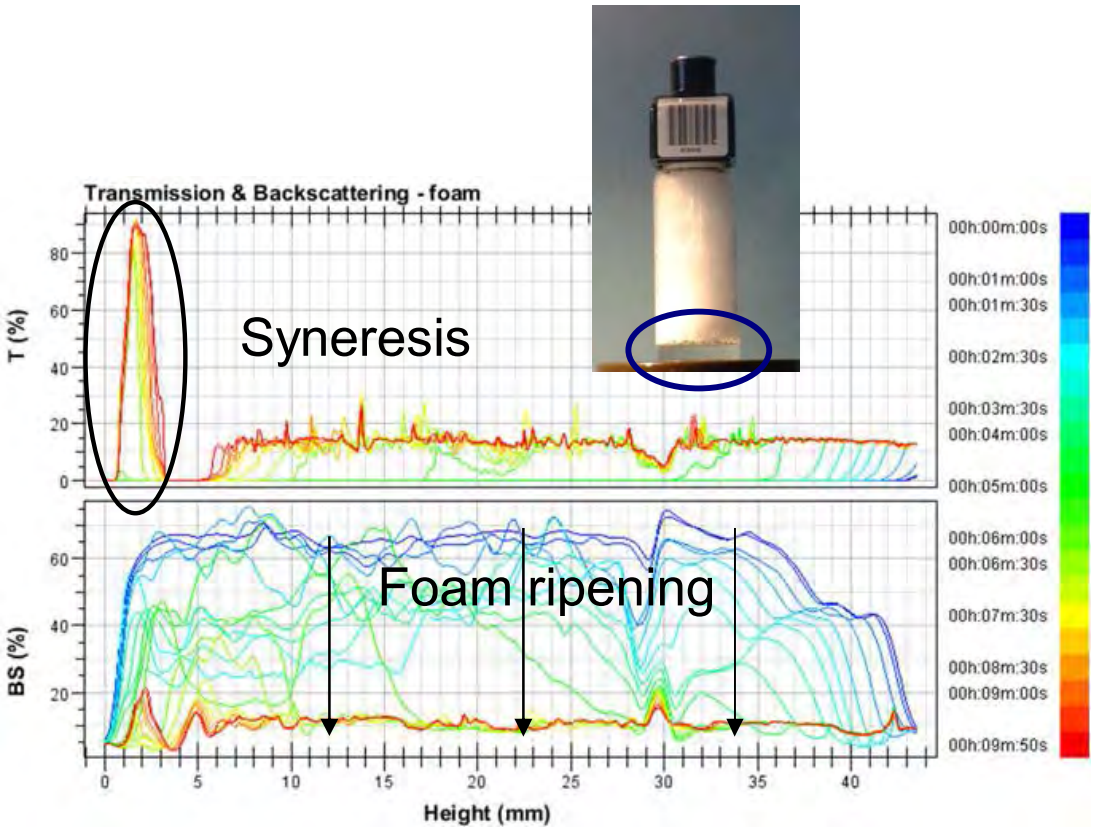
TSI Applications – Perfume stability with different fragrances

- Aim – Determine the stability of emulsions with added fragrances
- Fragrance A, B and C tested in the same emulsions, concentrations: 0%, 1% and 1.75%
- Usual test – 45 days at 45°C

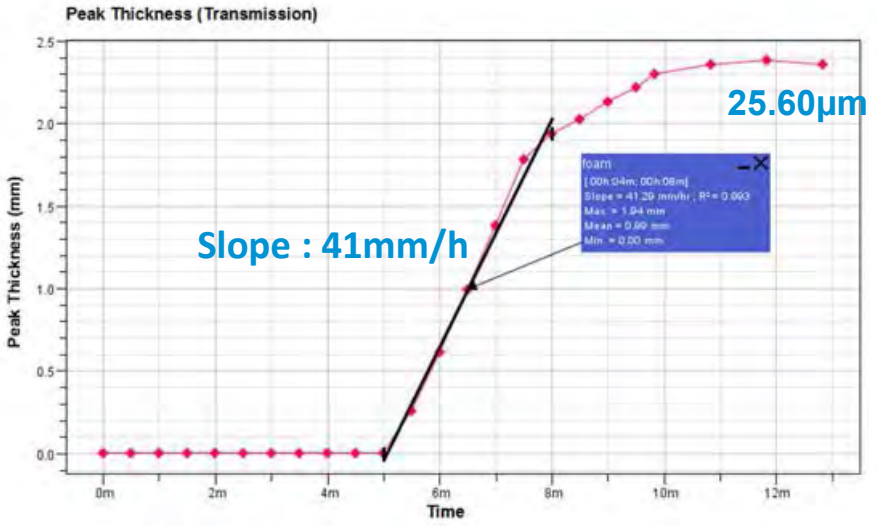




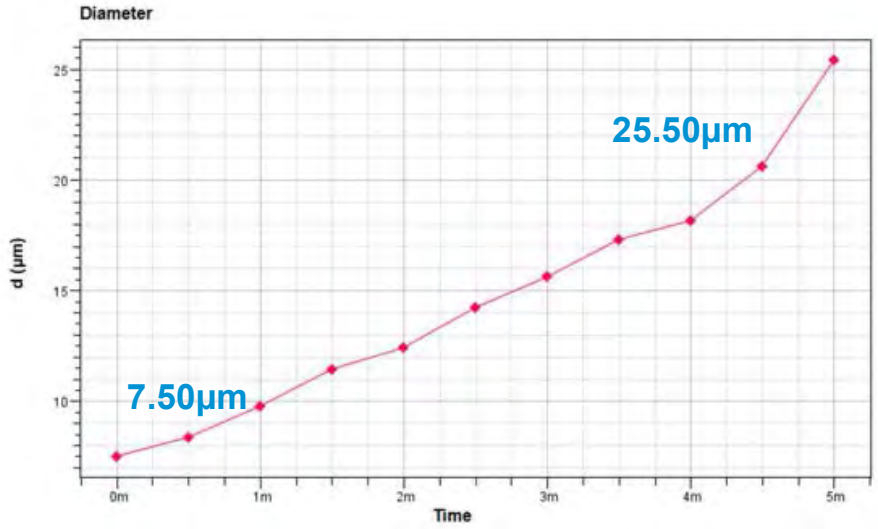
Turbiscan applications
Foam stability



- Drainage – Thickness of drainage phase



- Ripening – Diameter of bubbles



TURBISCAN
Formulation World

World of Formulation

Dispersibility
Make sure the suspending matrix and process are well adapted to minimized the energy

Size
Particle size in the native media and if any variations with time

Redispersion
If destabilization, Is it reversible ?
Energy required ?

Stability
…llowed over time is
…/or within the level
of acceptation. Shelf life

james@fullbrook.com

Sample testing and demo : contact me

More Information – www.fullbrooksystems.co.uk