
# Evaluating mean particle size in concentrated dispersions

## *- Static Multiple Light Scattering (SMLS) -*

GENERAL

### Introduction

Particle size measurement in native dispersions is of high interest in a wide range of industries (e.g. food, health, chemical and pharmaceutical industries). Many techniques allow to achieve particle size measurements, but most will require measurement conditions such as shear stress (e.g. centrifugation or filtration) or dilutions (e.g. dynamic light scattering, laser diffraction or microscopy) that may alter the original state of the dispersion. Turbiscan technology based on Static Multiple Light Scattering (SMLS) allows to overcome these limitations by providing an evaluation of the particle size even at high concentration and without denaturing the sample. This note provides theoretical explanations of particle size evaluation with static multiple light scattering (SMLS) technique.

KEY **BENEFITS**

NO DILUTION

ANALYSIS AT REST

ACCURATE

### Reference

Mengual, O., Meunier, G., Cayré, I., Puech, K., & Snabre, P. (1999). TURBISCAN MA 2000: multiple light scattering measurement for concentrated emulsion and suspension instability analysis. Talanta, 50(2), 445-456.

### Reminder on the technique

A monochromatic infrared light source (wavelength λ=880nm) is propagating in a dispersion (particles dispersed in a continuous phase) contained in a cylindrical glass cell. Two sensors collect the light scattered by the particles in the dispersed phase.

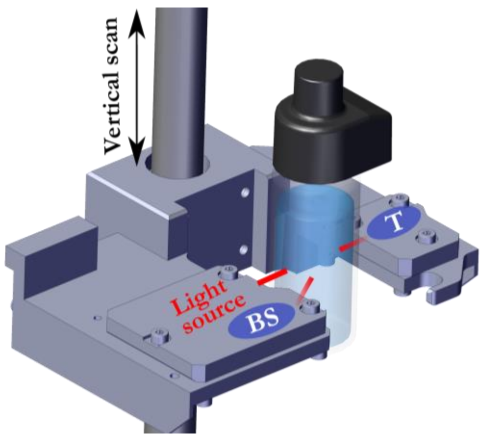


*Figure 1: Schematic representation of the SMLS principle*

One sensor is located at an angle of 0° from the incident light (i.e. in front of the source) and collect **the transmitted light T**. The second sensor is located at an angle of 135° from the incident direction and allows to collect the **backscattered light BS**.
**The transmitted signal T** is expressed by the **Lambert-Beer law**:

$$T = T_0 \exp\left(\frac{-2r_i}{l}\right) = T_0 \exp\left(\frac{-3r_i \phi Q_e(d)}{d}\right) \qquad (1)$$

With $T_0$ the transmitted signal of the continuous phase, $l$ the mean free path (average distance travelled by a photon between two particles), $r_i$ the internal radius of the cell, $d$ the particle mean size, $\phi$ the volume fraction and $Q_e$ the extinction efficiency.

$Q_e$ depends on the particles size $d$, refractive indices $n_p$ and $n_f$ of the dispersed and continuous phases and the wavelength $\lambda$, and is calculated thanks to the **Mie theory.**

The **backscattered signal BS** is approximated by:

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

$\alpha$ and $\beta$ are the gain and offset of the experimental setup which are defined during the manufacturing of the Turbiscan device.