



DISPERSIBILITY CHARACTERIZATION OF PIGMENTS & COATINGS WITH STATIC MULTIPLE LIGHT SCATTERING

INTRODUCTION

Suspensions with nano and submicron particles are considered of great potential for various fields like pharmaceutical applications, coatings, nanocomposites materials, and cosmetics...

Their dispersibility, which corresponds to their property of being well distributed in terms of size and concentration at a given time after a dispersion process, is of great interest as it influences final end-use properties like homogeneity, stability, polishing... Because of size, surface area, concentration, zeta potential, affinity with solvent, or any other parameter, particles may aggregate, agglomerate and sediment.

Dispersibility is a multiparametric property, which has to be measured on the native sample, without sample preparation. Common size measurement techniques may alter the dispersed phase or the apparent particle size due to the principle of measurement or the sample dilution.

In this note, we propose a method to assess the dispersibility for two typical applications: titanium dioxide and talcum powder.

PRINCIPLE

Measurement with Turbiscan®

Turbiscan is based on SMLS technology (Static Multiple Light Scattering) and enables to measure directly the mean spherical equivalent diameter (d_{measured}), knowing refractive index of continuous (n_f) and dispersed phase (n_p) and the particles concentration (φ) according to the Mie theory: $BS = f(\varphi, d, n_p, n_f)$ with BS for Backscattering Intensity. This technique requires no sample preparation.

Dispersibility ratio

The dispersibility is defined as a characteristic, which quantifies the ability of a solid particle to be spatially well distributed in terms of size and concentration in a liquid after a controlled dispersion process, to reach a state as close as possible to the primary particle size or required size.

A quantification of the dispersibility is given with the dispersibility ratio Dr :

$$Dr = \frac{d_{\text{theoretical}}}{d_{\text{measured}}}$$

The theoretical diameter $d_{\text{theoretical}}$ corresponds to the diameter that can be obtained with the highest rate of dispersibility. The measured diameter d_{measured} corresponds to the diameter measured with SMLS on the dispersion without dilution.

When Dr is close to 0, the dispersibility is bad, when Dr is close to 1, the dispersibility is good and when Dr becomes greater than 1, the dispersibility enables to obtain particles better dispersed than the size given by the manufacturer (which is often measured by DLS or TEM...).

DISPERSIBILITY

Case 1 - Dispersion of TiO_2 in water

Titanium dioxide is the most important white pigment used in the coatings industry. It is widely used for its efficiency to scatter the light for coating applications. Nevertheless, bad dispersibility can affect its performance as it will decrease its opacifying effect.

Two different ways of dispersion have been tested to determine dispersibility of titanium dioxide powder in water: mechanical and chemical.

Mechanical stirring or ultrasonication for dispersion can reduce agglomeration among particles by breaking large agglomerates into smaller ones or even primary particles.