



Ultrafine bubble characterization

Stability monitoring by S-MLS

Introduction

Ultrafine bubbles are defined by their size (less than 1 μm), they offer additional features compared to ordinary bubbles: they stay longer in a liquid and lower the surface tension. Their properties have long been used but the technology keeps on expanding to new applications in various fields such as toilet detergency, cosmetics, medical, semi-conductor, and agriculture for vegetables growing acceleration.

The challenge is the detection and characterization of these very fine bubbles to highlight their efficiency. Static Multiple Light Scattering is proposed to monitor ultrafine bubble stability in water, but also to determine bubble size and concentration.

KEY BENEFITS

FAST
NO DILUTION
SENSITIVE

Reminder on the technique

Turbiscan® technology, based on Static Multiple Light Scattering, consists on sending a light source (880 nm) on a sample and acquiring backscattered (BS) and transmitted (T) signal all over the height of a sample.

By repeating this measurement over time at adapted frequency, the instrument enables to monitor physical stability.

The technology also enables to measure directly the mean spherical equivalent diameter (d), with the signal intensity and knowing refractive index of continuous (n_f) and dispersed phase (n_p) and the particle concentration (φ) according to the Mie theory:

$$BS = f(d, \varphi, n_p, n_f)$$

with BS for Backscattering Intensity and T for Transmission Intensity. In return, the volume fraction can be computed knowing refractive indexes and diameter.

Method

Samples of ultrapure water were analyzed and results compared with samples charged with ultrafine air bubbles at two concentrations (low LC and high HC).

Ultrafine bubbles signal sensitivity

The samples analyzed are transparent, thus only transmission signal is to be taken into account. Figure 1 shows the transmission level for ultrapure water and ultrafine bubbles in water. Since Turbiscan® signal reproducibility is 0.1%, any variation greater than 0.1% is to be considered significant.

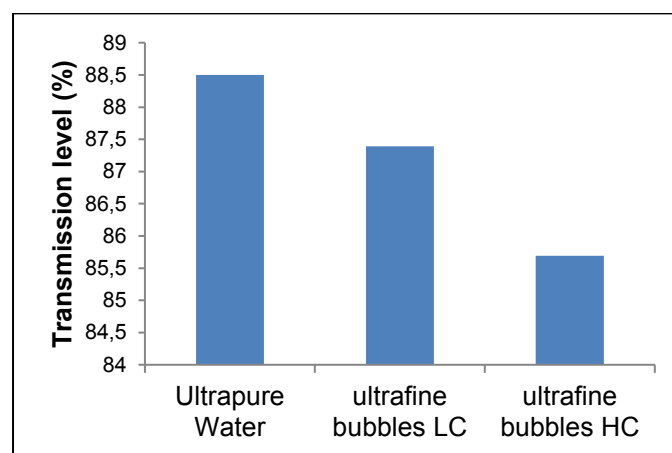


Figure 1: Transmission level (%) for ultrapure water and water with ultrafine bubbles at low (LC) and high concentration (HC)

The transmission signal measured with Turbiscan® is sensitive to differentiate ultrafine bubbles at different concentrations. The transmission intensity decreases with higher air bubble concentration.