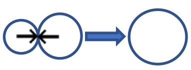
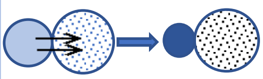
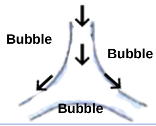
Foamability and Foam Stability with Turbiscan®

Foams are very common in everyday life, constitute many food products, cleaning products, hygiene, and health formulations but are also used for construction materials (heat and noise insulation, shock-absorbers) or for light-weight materials in aerospace/automotive fields. On the other hand, in some cases, foam is the undesired subproduct and must be limited (papermaking, printing). Measuring and analyzing foam remains a challenge due to the diversity of the phenomena involved. This note shows how Turbiscan®, based on SMLS technology, provides relevant and reliable method to fully characterize foam stability: Foam height, bubble size, foamability…

Definition: Foam

Foam is the union of two-phase systems. It is a dispersion of gas in a condensed phase which is most often an aqueous phase but can be also solid. Adsorbed at the surface of the bubbles, surfactants reduce the surface tension of the interfaces (bubbles/lamellae) and have an important role for foamability, foam stability and foam quality.

Foamability depends on surfactant nature, concentration, and the liquid phase viscosity. Foamability (related to the amount of foam generated) and foam stability are two separate properties to consider. There are three main process of foam destabilization:

Bubble Coalescence	Bubble Ostwald ripening	Water drainage
		
Rupture of a film separating two bubbles within a foam	Because of the Laplace pressure difference, the smallest bubbles empty into the large one by diffusion through the liquid films	Flow of the liquid out of the lamellae

These phenomena, often coupled, lead to an increase in the size of the bubbles and over time phase separation between the liquid and the gas. Indeed, water drainage facilitates coalescence.

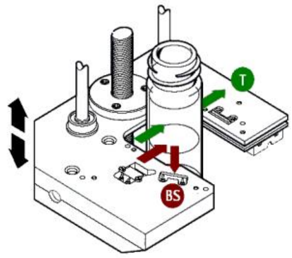
Most used method for foam study is based on visual observation. It is user dependent and not sensitive for such short-lived systems. Some indirect methods also analyze the behavior of an isolated film but it's not always possible to correlate it with the global behavior.

The Turbiscan® is a reliable tool for precise foam study. The foam height (during formation) and the foam destabilization over time can be precisely measured.

Turbiscan®: How it works

Turbiscan® technology, based on **Static Multiple Light Scattering (SMLS),** consists of sending light pulses (880 nm) into a sample along its height. The reading head scans the sample by moving vertically along the cell's height and acquires data every 20 µm. Scans are made over time and the intensity of backscattered and transmitted light is recorded. The variation in signal intensity translates to sample instability.

The signal is directly linked to the evolution of particle concentration (φ) and size (d) by the Mie theory.



$$BS = f\,(\varphi, d, np, nf)$$

Samples with a particle concentration from 10^{-4} to 95% (v/v) and from 10nm to 1mm in particle size can be measured as is. The instrument enables to monitor changes in physical stability (coalescence, creaming, sedimentation, phase separation, etc...) for any type of dispersion, including foams, **without any dilution or any stress**.

Turbiscan® profiles show the variation in recorded light intensity levels as a function of sample height (in mm) over the time. The bottom of the sample is represented on the left of the graphic and the top of the sample on the right. The color gradient on the time scale corresponds to each scan time lapse with the **first scan in blue** and the **last scan in red**.